APRIL 1960

PLASTICS

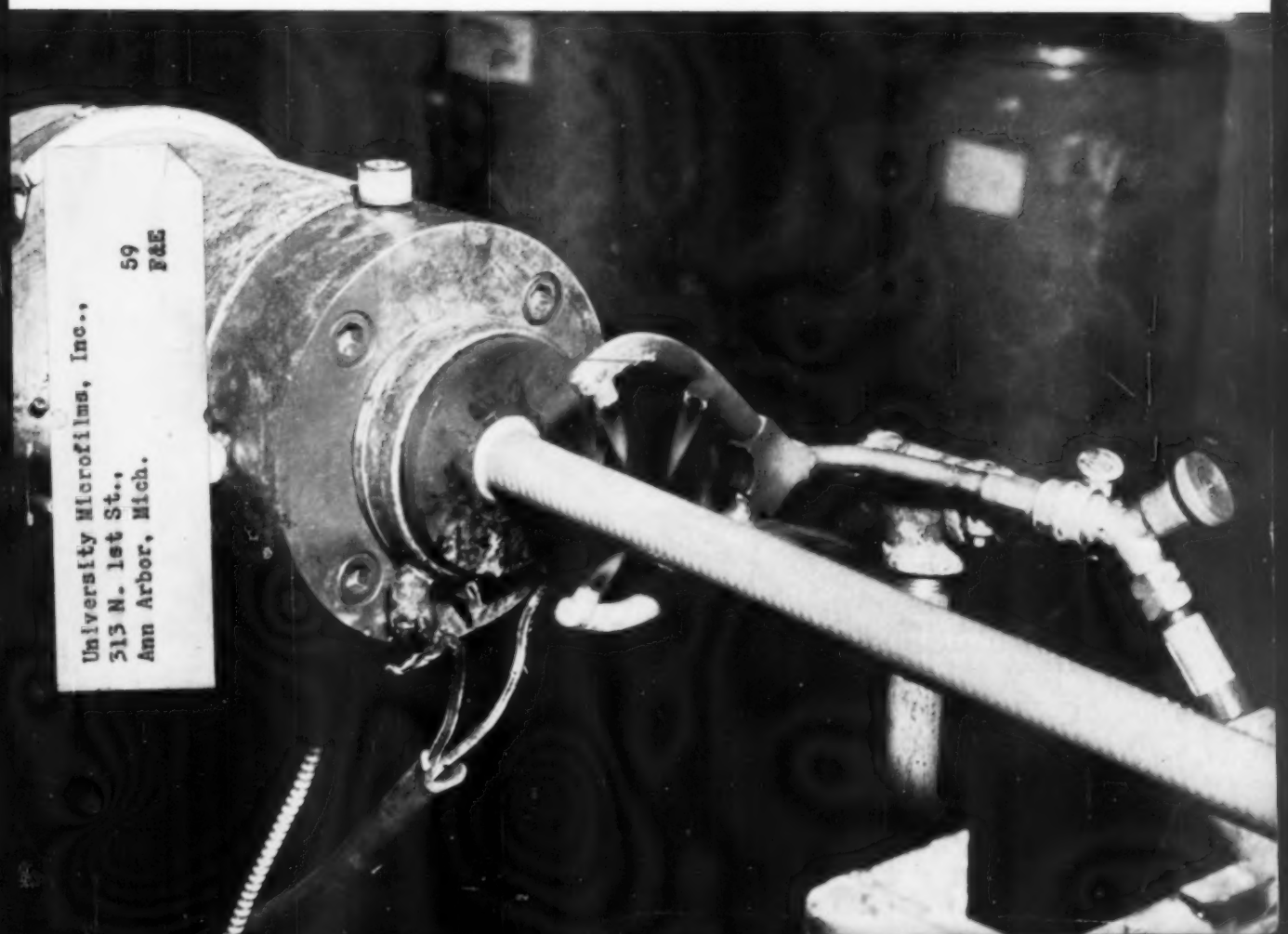
THE MAGAZINE OF APPLIED ENGINEERING

TECHNOLOGY

Stabilizing vinyl copolymers

Polyethylene copolymers

Heat-resistant encapsulating resins



University Microfilms, Inc.,
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F&E

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Catalin Corporation of America Catalin **One Park Avenue, New York 16, N. Y.**

PLASTICS

THE MAGAZINE OF APPLIED ENGINEERING

TECHNOLOGY

April 1960, V. 6, No. 4

feature articles:

stabilization of vinyl copolymer resins ..... p. 35

by G. A. TANNER

Results are given for a test program involving vinyl chloride-vinyl acetate and vinyl chloride-vinylidene chloride copolymers, plus two modified PVC formulations. Stabilizers tested were barium-cadmium lead, tin, and epoxy types. The complexity of test results and the need for their proper interpretation are stressed, together with the need for processors to check test results using their own specific formulations.

polyethylene copolymers ..... p. 39

by D. A. JONES

This new class of olefin resins is discussed, covering chemistry of the materials, properties and their influence on processing characteristics, and their suggested fields of applications. Differences between polyethylene copolymers and homopolymers are emphasized, plus how these differences affect properties, processing conditions, and use applications.

heat-resistant encapsulating resins ..... p. 43

by MAX M. LEE and R. D. HODGES

The heat-resistance values for several types of encapsulating resin systems are of major importance because of the effect of high temperatures on many significant properties. The heat-resistance of an encapsulating resin system should not be evaluated on the basis of one property only, but only on the results obtained in a combination of thermal tests. A complete evaluation of the resin can only be determined by applying it in the specific end-product.

guest editorial:

industrial publicity—just the facts ..... p. 49

by S. J. SAUNDERS

Advances in the Technology of Plastics:

developments in vinyl and related materials during 1959 ..... p. 51

by WILLIAM CUMMINGS

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injection molding ..... p. 55

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did macy's tell gimbels! ..... p. 42

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Cover photo courtesy:
Borden Chemical Company.
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Opinions expressed by contributors do not necessarily reflect those of our editors

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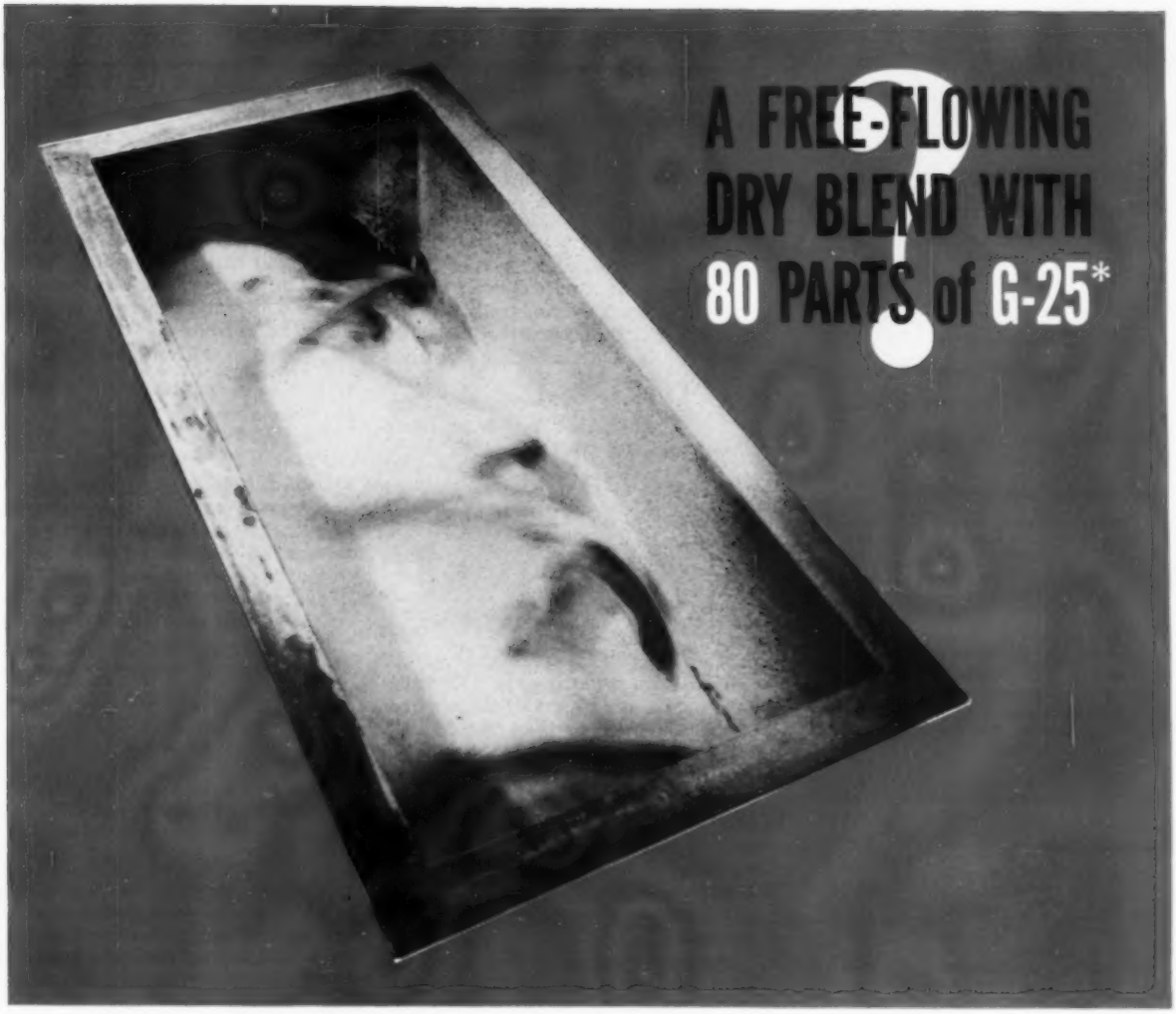

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Letters to the Editors

Explaining Omissions

Dear Sirs:

We would like to be included on your next list of auxiliary equipment for Thermoforming and Compression and/or Transfer Molding if you plan to put out such a list again next year.

Although we could find no classification for our conveying equipment, we feel that this is an important aid to the molders using thermoforming or compression processes.

D. C. Whitlock, Adv. Mgr.
Whitlock Associates, Inc.
Oak Park, Mich.

•

Dear Sirs:

Although not unaware of the job it must be to put together your excellent magazine, I still expect that the staff of a publication specializing in a particular field such as does yours would be rather broadly knowledgeable in that field.

Therefore, it was disappointing to find that in your February issue under the section "PT's Classified List of Auxiliary Equipment for Thermoforming and Compression and/or Transfer Molding" you omitted the names of several reputable makers of Press Cycling Controlling instruments, including ours.

We very much hope that next year when you repeat your Special Issue we will not be given the silent treatment.

A. M. Patterson, Pres.
Seely Instrument Co., Inc.
Niagara Falls, N. Y.

(We offer our sincerest apologies to both companies for the unintentional omission of their names from the Classified List of manufacturers of auxiliary equipment that appeared in our February issue. In checking a list of hundreds of company names, our editorial staff and the Review Board members proved themselves capable of human error and missed a few companies that should have been listed. Both above companies have been added to the listing of injection molding auxiliary equipment that will be printed in our forthcoming May issue. Such listing should assure their inclusion in all future lists of the same nature that will be printed in this publication. We would appreciate being advised of any other additions, deletions, or omissions.—Editor)

• • •

Cold-Casting Polyethylene?

Dear Sirs:

As a designer of artwares, I am often asked about the possibility of cold-casting polyethylene-type flexible plastic into flexible rubber molds which would allow undercuts on figurines, plaques, etc. Can you tell me whether this is being done, and where I might find more information?

Vaughn Kendrick
Barrington, Ill.

(In answering, Lee Zukor, our Engineering Editor, advised that polyethylene cannot be "cold cast". It is possible to cast polyethylene by sintering powdered resin after a high-compression briquetting operation. It also is possible to dissolve the material in a hot solution of cyclohexanone at a temperature of about 300° F. This hot solution could not be poured into a rubber mold for various reasons. The "lost wax" method was suggested to best handle undercuts, etc.—Editor)

• • •

Controversy—Part 2

Dear Sirs:

If there were any doubts that your publication upholds the traditions of freedom of the press, these were certainly dispelled by the first Letters to the Editor in your February 1960 issue (p. 4) entitled "Controversy on Publicity Value."

Anyone who has read my Guest Editorial in your December 1959 (p. 45) will agree that its main purpose was to give an exposition on the professional approach to industrial and technical publicity. No further answer is needed to what are obviously personal remarks.

Harold Schor, Pres.
Harold Schor Assocs.
New York, N. Y.

(Before we allow this controversy to continue, what do our readers think?—Editor)

We invite letters from our readers for publication in these columns. Such letters may be of comment or criticism, requests for information, or of general interest. The only requirement is that all letters must be fully identified as to name of sender, company affiliation and address.

A letter will not be printed if publication is not desired by the sender, and the identity of the writer will be withheld, if desired.

—The Editor

PREVIEWS

of Next Month

The May issue will feature the following articles:

Multi-Gating Techniques for High-Density Polyethylene. C. L. Weir, Sr. Technical Service Engr., Polymer Chemicals Division, W. R. Grace & Co., Clifton, N. J.

New techniques are described for multi-gating of linear polyethylenes to improve their filling of parts at lower temperatures during injection molding. Differences and advantages are given for three-plate molds; heated-torpedo, multiple-nozzle molds; insulated-runner molds; hot-runner molds; and valve-gated molds. It is emphasized that methods for multiple-gating for other plastics materials do not necessarily hold true for high-density polyethylene.

•

Production Processes for Gel-Coated Glass-Polyester Plumbing Fixtures. J. A. Wills, Plastics Consultant, Pasadena, Calif.

Reinforced-plastics plumbing fixtures require economical, reliable tooling; proper formulations of gel coats; and suitable production processes. The second and third requirements are explained in this article. Gel-coat types, formulations, and techniques for their preparation, mixing, and application are discussed in detail. Mold construction, mold materials, and preparation of mold surfaces for molding also are discussed. Finally, the different molding methods are described, together with their advantages and limitations.

•

SPECIAL SECTION

Matching Injection Molding Equipment for Optimum Performance and Economy. G. B. Thayer, Plastics Specialist, The Dow Chemical Co., Midland, Mich.

PT's Comparative Data on 1960 Injection Molding Machines.

PT's Classified List of Auxiliary Equipment for Injection Molding.

•

The Guest Editorial will be: "Instrumentation as Seen at the 1959 Dusseldorf Plastics Exhibition," by Herbert Proske, N. Y. District Mgr., Wheelco Instruments Div., Barber-Colman Co., Rockford, Ill.

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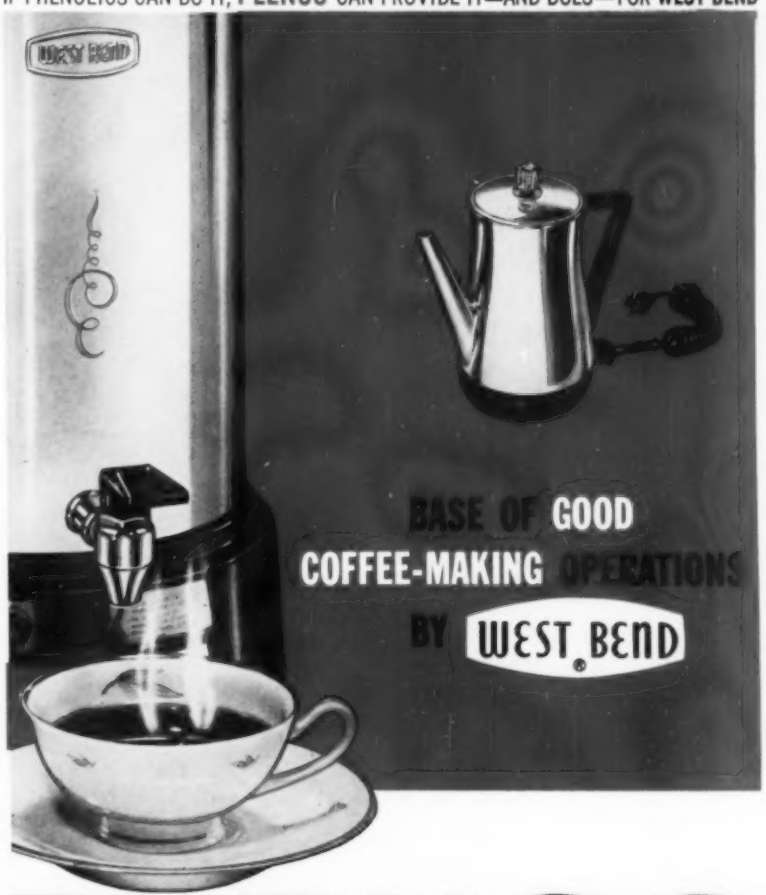

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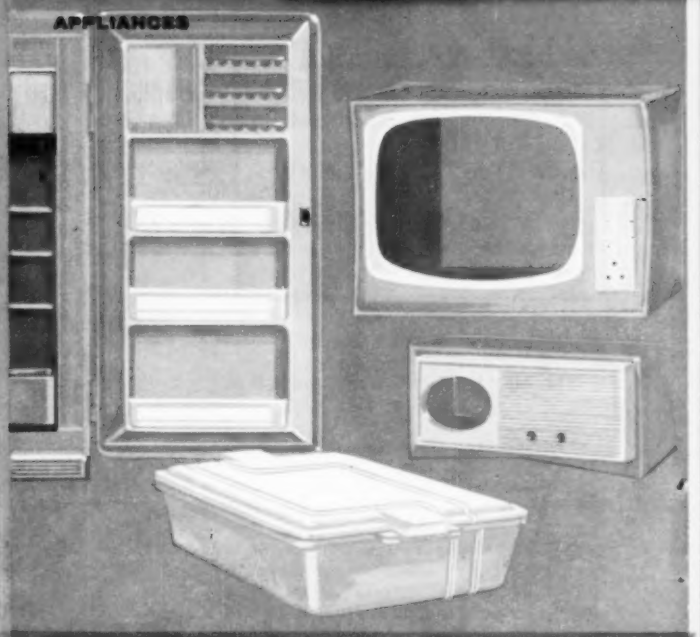

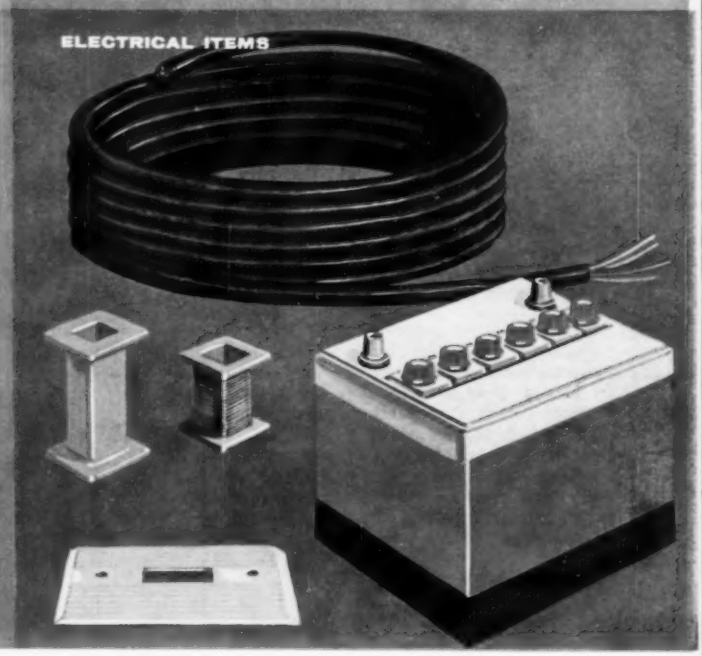

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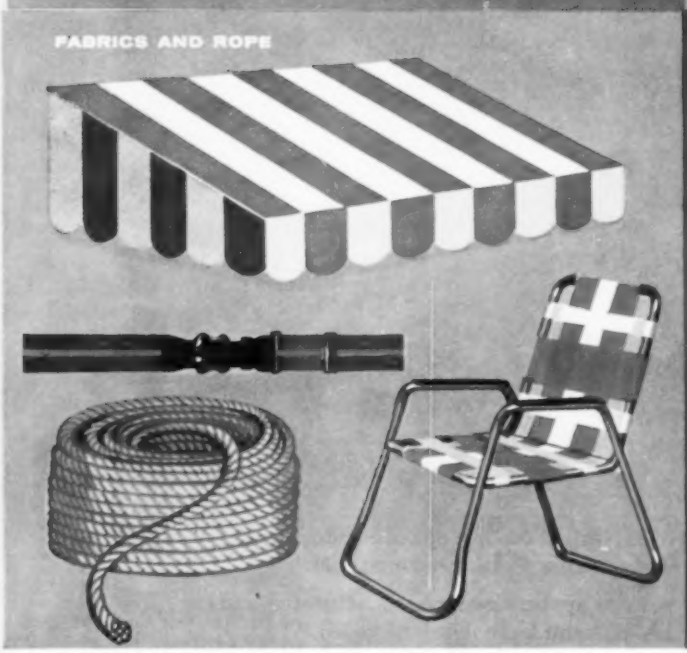
CONTAINERS AND CLOSURES . . . rigid bottles and closures for detergents, bleaches and chemicals—rigid containers of all shapes and sizes. Containers of AviSun Polypropylene are rigid, strong and highly resistant to cosmetics and essential oils. Closures have low creep and good resistance to cold flow. In addition, they do not stress crack and are considerably stronger than the other plastics they replace.

APPLIANCES . . . refrigerator door liners, freezer trays, TV and radio cabinets, TV yokes, intercoms, air conditioner grilles, and vacuum cleaner tools, bobbins, gears, rollers. Appliance components can be molded of AviSun Polypropylene at *remarkably low cost*. They're strong, rigid, highly heat resistant—have excellent dimensional stability and low cold flow.

ELECTRICAL ITEMS . . . wire and cable insulation, as well as electrical components offer a good potential use for AviSun Polypropylene. It is a non-polar material with excellent dielectric properties, high volume resistivity and low moisture absorption. Also has remarkable heat resistance, abrasion resistance and weatherability. Battery cases, coil forms and insulators are suggested uses.

AUTOMOTIVE AND AIRCRAFT PARTS . . . dome lights, dashboards, control knobs, steering wheels, visors, windshield washer reservoirs and auto upholstery monofilaments. Great resistance to stress cracking and heat, plus toughness and rigidity make AviSun Polypropylene ideal for many automotive applications. Its light weight and *economy* add to its appeal in this field.

FABRICS AND ROPE . . . marine rope, bristles and industrial fabrics, automobile upholstery, awnings, furniture webbing and filters offer great promise as end products for monofilaments made from AviSun Polypropylene. It is lightweight (actually floats), is mildew proof, and has high tensile strength as well as outstanding wearability and resistance to chemicals and moisture.



with AviSun Polypropylene

HOUSEWARES AND TOYS . . . coffeemaker parts, cups, saucers, dishes—both intricate and giant-size toys. AviSun Polypropylene is easy to injection and blow mold with fast cycles and low shrinkage. Ideal for stiff, thin-walled items. Can be molded in bright colors—resists oils, detergents, bleaches. No warpage, even in high-heat dishwashers.

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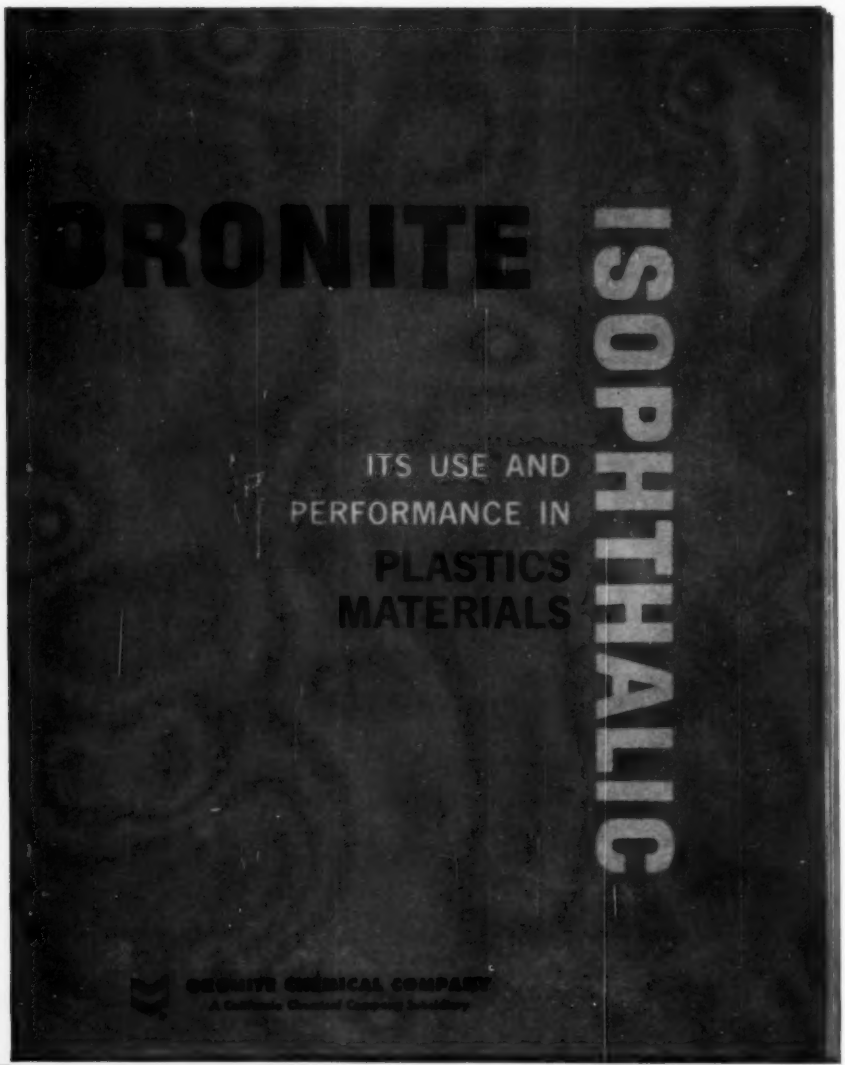

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Get to know Oronite Isophthalic and the technical service available to users and potential users. Contact the nearest Oronite office for your copy of the new Isophthalic plastics brochure.

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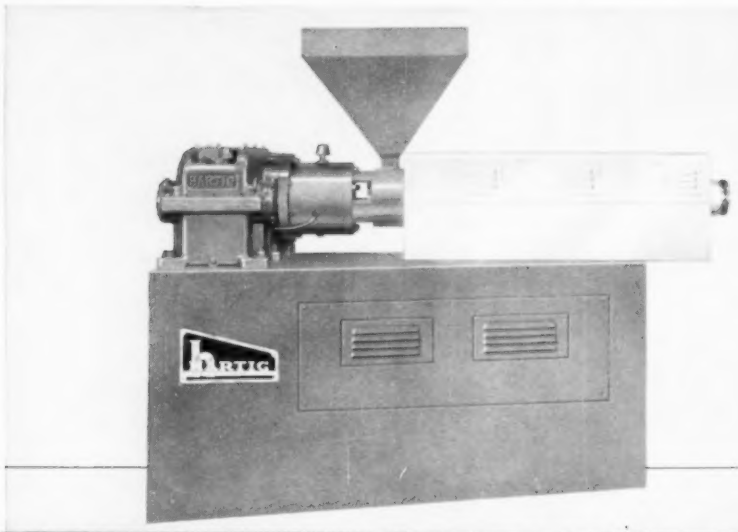

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U.S.I. POLYETHYLENE NEWS

A series of advertisements for plastics and packaging executives by the makers of PETROTHENE® polyethylene resins

APRIL, 1958 — U. S. Industrial Chemicals Co., Division of National Distillers and Chemical Corporation — 99 Park Ave., N. Y. 16, N. Y.

Packaging Notes

A new polyethylene pouch-in-carton has been adopted by a west coast food concern for packaging frozen fruits in syrup. According to company officials the new container saves 35% over previous packaging costs for lithographed composite fiber-metal containers.

The package consists of a 2.75-mil heat-sealed polyethylene pouch inside a standard lock-tab folding carton with overwrap. The firm reportedly uses a continuous pouch forming-filling-sealing machine which turns out 3,000 pouches per hour.

Retailers are said to like the conventional size and shape of the overwrapped packages. Consumers like the fast, leak-proof thawing and ease of opening offered by the new frozen food container. Thawing time for the pouch pack is said to be only 9½ min. in 100° F. water, as compared with 45 min. for conventional fiber containers.

Now, scented polyethylene for packaging, molded items: a new dimension—aroma—has been added to polyethylene packaging films and molded items. Crystal-clear polyethylene films now can be made to create packages that pleasantly affect the senses of both sight and smell. This added sensory dimension is expected to stimulate sales still further for items packaged in polyethylene.

A wide variety of scents have already been developed, including such aromas as "clean linen" for fresh laundry packages, perfume for packaging women's lingerie, sweaters, handkerchiefs, and stockings, and lavender, tweed, cedar, pine, and spruce for men's sport clothing packages. Other aromas such as "cookie", "baked goods", spearmint, chocolate, lemon, orange, and lime will be offered by the manufacturer in the future, pending F.D.A. approval.

The fragrances are sold in the form of polyethylene/scent concentrates, which are dry blended with U.S.I. PETROTHENE film grade resin in making scented film. Between ¼ and 2½ of scented polyethylene concentrate is used, depending on the scent. The manufacturer of the scent concentrates claims to be able to scent resins of any density or melt index required by the extruder, and that all aromas become an integral part of the polyethylene film—they cannot be washed away.

U.S.I. Opens Polyethylene Housewares Exhibit

An educational exhibit, designed to show retailers and manufacturers how quality polyethylene housewares are made was recently opened by U.S.I. The exhibit is located in the Housewares Building, 1150 Broadway or 230 Fifth Ave., New York City.

Occupying a space in the building's main lobby, the exhibit tells the story of polyethylene from manufacture of quality resin to production of quality goods through modern molding techniques. The display includes photos of plant facilities and samples of fine molded houseware articles.

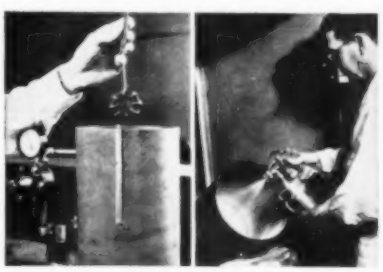
U.S.I. Introduces "MICROTHENE" Finely Divided Polyethylene

Resin in Powder Form Expected to Expand Use of Polyethylene in Textile, Metal and Many Other Fields

Polyethylene in finely divided or powdered form is now being produced by U.S.I. and is available in sample and semi-commercial quantities under the tradename "MICROTHENE". Already in use in Europe, finely divided polyethylene is expected to open many new markets for the resin in this country and to expand a number of existing ones. Some of the applications foreseen include its use in the coating of metal, textile, paper, glass and wood products, as a binder for non-woven fabrics, and as molding powder for production of large polyethylene items such as boats, tanks, and shipping drums.

Methods of Application

In coating operations, MICROTHENE polyethylene can be applied to the substrate in its original powder form, as an organic or aqueous dispersion, or as an organic or aqueous paste. The method selected depends largely on the substrate to be coated, the major requirement being that the substrate be able to withstand the heat necessary to fuse the resin into a continuous coating. In the coating of woven and non-woven fabrics, dry polyethylene powder or a paste is generally spread evenly onto a moving web, which then passes through an oven to sinter the plastic into a film coating. Metal parts can be coated by spraying, dipping, or slush coating with either the dry powder or dispersions. Organic dispersions are generally used on metals that would be corroded by water. With modifications of application techniques, strippable polyethylene metal coatings may be possible.



Two methods for coating metal with MICROTHENE finely divided polyethylene are shown above. Hot object is dipped in fluidized bed of powdered resin, left. Resin dispersed in organic liquid is applied by ordinary spray equipment, right.

Fluidized Bed Technique

Irregularly shaped objects, wire, and other metal items can also be coated with inexpensive equipment employing the fluidized bed technique. The item is first preheated, dipped into a container with the fluidized dry powder, and then cooled or post-heated to achieve a smooth, continuous coating.

Plastic Moldings

Another potential market for MICROTHENE finely divided polyethylene is in the field of large plastic moldings. The powder is poured into heated molds which shape the polyethylene as it melts on the surface of the mold. Excess powder is then poured out. The molds required are extremely simple and inexpensive. Large containers, drums, and even small boats have been made successfully by this technique in Europe.

Two MICROTHENE Resin Types Available

U.S.I. is initially marketing two types of MICROTHENE polyethylene. One type will be similar to PETROTHENE 202 resin (melt index 22, density 0.916); the other type will be similar to PETROTHENE 206 resin (melt index 5, density 0.924). As new market requirements develop, other types of resins will be made available in finely divided form by U.S.I.

Each of the above resins is available in two forms: fine (smaller than 200 mesh) which is made by a solution process; and coarse (50 to 100 mesh) which is made by a mechanical grinding method. Both types of powder will have their own fields of application.

Production Facilities

U.S.I. is now producing MICROTHENE polyethylene at Tuscola, Illinois, site of one of U.S.I.'s two polyethylene plants. The plant, which went on stream in March, has an initial capacity of 2 million pounds per year and is designed for fairly rapid expansion.

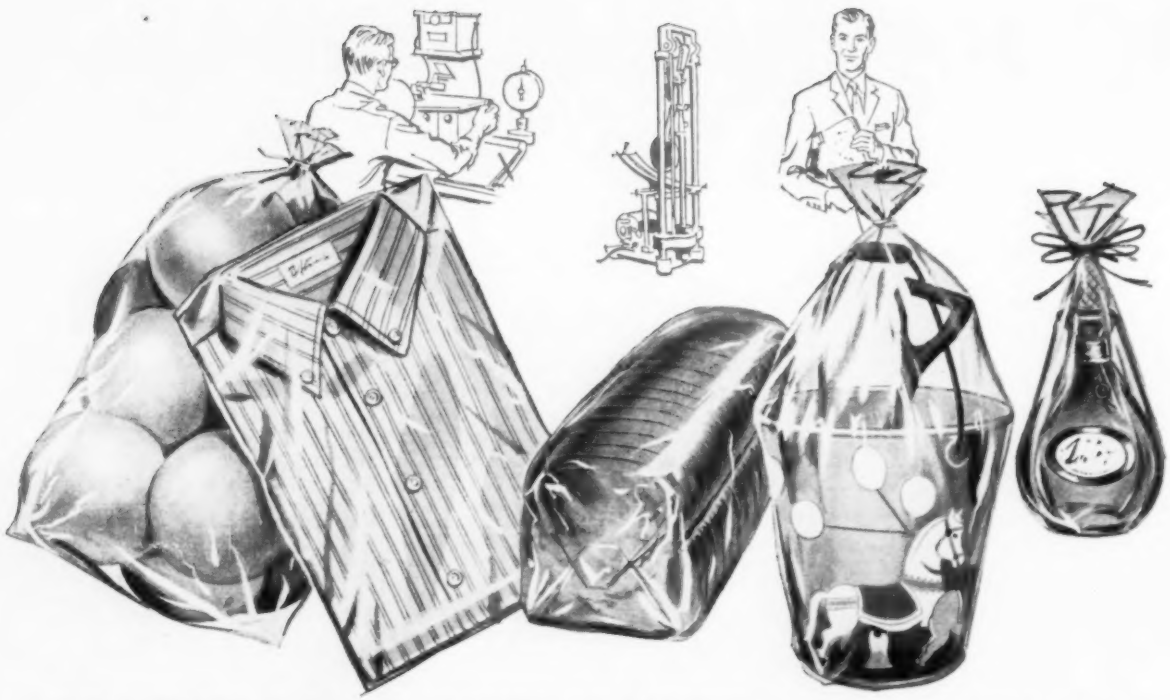
Samples of MICROTHENE finely divided polyethylene, and a Technical Data Sheet giving detailed product information may be obtained by writing U. S. Industrial Chemicals Co.

U.S.I. Announces Booklet On Polyethylene Printing

"Printing of Polyethylene" is the title of a new U.S.I. booklet just off the press. It's the latest addition to special U.S.I. literature designed to help achieve finest results with polyethylene packaging film.

The new booklet discusses methods of film treatment, printing techniques, printing inks, and field test procedures. It also contains a glossary of commonly-used ink and printing terms.

A copy of this valuable 16-page booklet is available upon request. Just write to U. S. Industrial Chemicals Co., 99 Park Ave., New York 16, New York.



U.S.I. HELPS IMPROVE CLARITY OF POLYETHYLENE PACKAGING FILM

. . . helps expand your markets for it, too

From shirts to sugar cookies . . . your customers are finding their products look better, sell better when packaged in polyethylene. You can now produce polyethylene film with better clarity than ever before thanks in large part to these U.S.I. research and development services:

FINER RESINS

U.S.I. has developed a number of different PETROTHENE® resins . . . so that you can produce polyethylene film with a complete range of toughness and clarity to suit any end use. These resins are manufactured under rigid quality control conditions to assure resins of the highest uniformity for packaging use. To help you obtain maximum results from these resins, U.S.I. offers literature containing tables and technical information to assist you in choosing the most suitable resin for your particular applications.

NEW PRODUCTION TECHNIQUES

Engineers at U.S.I. are constantly seeking methods for producing better films with PETROTHENE resins. The clearest polyethylene film available today is made by a chill-roll casting process which U.S.I. pioneered. Cast film offers unprecedented clarity and gloss without sacrificing needed strength. Since its development, the process has sparked many new uses for polyethylene film.

U.S.I. has also contributed to higher clarity in blown tubular film with a new annealing chamber technique for film extrusion. When properly used, the technique produces blown film of markedly improved clarity, with practically no impairment of other physical properties.

TECHNICAL ASSISTANCE

A Polymer Service Laboratory is maintained by U.S.I. to help extruders solve production and processing problems. Experienced Technical Service Engineers will be glad to work closely with you on evaluating new resins and assist you in any processing problems. This service is confidential and without obligation.

A wealth of technical literature is also available from U.S.I. to help you take full advantage of the quality of PETROTHENE resins. These booklets cover many phases of processing and use of polyethylene and are available upon request.

ADVERTISING AND SALES PROMOTION

U.S.I. conducts a coordinated advertising and sales promotion program which is designed to help build markets for your polyethylene products. Advertisements directed to *your* customers and prospects appear in leading magazines in the baking, produce, candy, dairy, apparel and food fields. Other U.S.I. polyethylene packaging literature reaches film users and package designers regularly by direct mail.

U.S.I. ads appear in leading magazines to help build your markets for polyethylene film.

U.S.I. INDUSTRIAL CHEMICALS CO.

Division of National Distillers and Chemical Corp.
99 Park Ave., New York 16, N. Y.
Branches in principal cities

NOW
SPENCER CHEMICAL joins growing list of

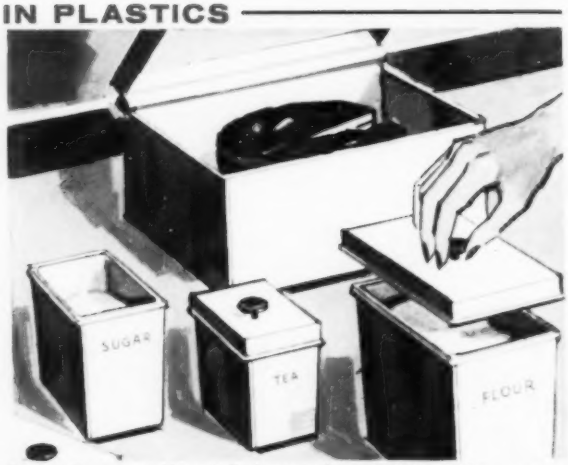
The Spencer Chemical Company has installed a 3½", 24:1 L/D custom-built, extra-long extruder at their sales service laboratory in Kansas City for laminating polyethylene to paper. Versatility figured importantly in their choice of this Sterling unit. Extruder is mounted on a rotary table, allowing use in different positions for lamination, cast-film, blown-tubing and blow-molding.

The Sterling Extruder is a unit of superior performance and service, a product of long experience in the plastics industry. Sterlings are available in sizes 1½" through 6", with L/D ratios of 21:1, 24:1, or 30:1. Sterling offers a full-range of variegated units and installations for both standardized and specialized requirements. For full details, write to—

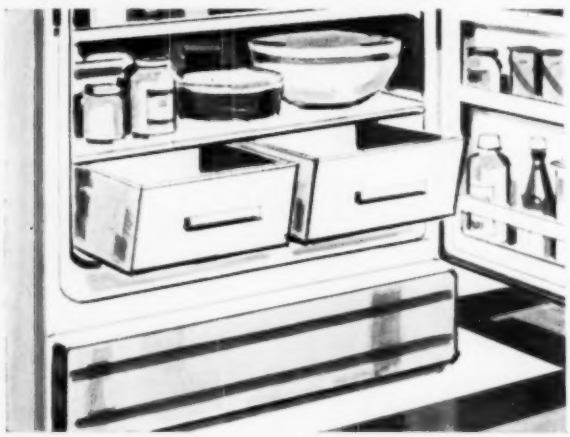
STERLING EXTRUDERS — *"Designed by plastics men for plastics men"*

1112 Baltimore Avenue, Linden, New Jersey • WAbash 5-3908

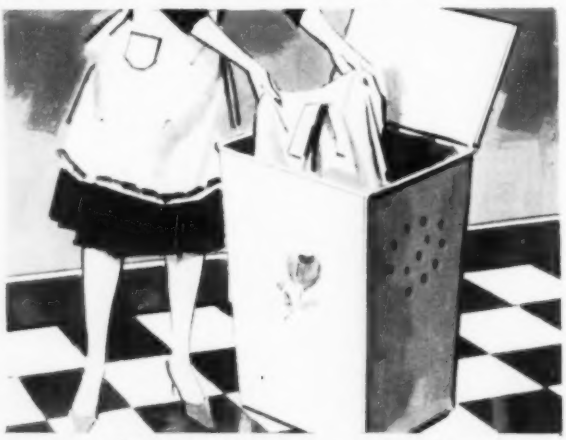
Beats the Heat! Housewares made of Escon get repeated use without warpage. That's because the heat resistance of polypropylene is greater than any other polyolefin. This makes it the desired material for such items as colanders, drainboards, dishpans, tumblers and lighting grilles.



Fresh Point of View! Polypropylene is 2 to 4 times more impermeable to gases and liquids than other thermoplastics. This means freshness stays in, outside elements can't enter. This makes Escon ideal for canister sets, bread boxes and cookie jars—which can be snap-fitted or self-hinged.



Cool Item! Escon is excellent as a food crisper for several reasons. It won't absorb strong food odors and, when properly molded, has the ability to take normal cold without cracking. The design possibilities with versatile Escon are limitless, providing the opportunity to expand existing markets.



New Idea! Escon can be undercut at high speed production cycles. Such items as clothes hampers can be molded in single flat pieces of various colors, then snap-locked for assembly and hinging. This means manufacturers can ship more products in less space . . . retailers will use less storage space, too.

Escon* POLYPROPYLENE CATCHES HER

Important news for molders and designers . . . Escon polypropylene is here! It's the amazing thermoplastic ideally suited to your product needs.

Versatile Escon is easy to work with! It can be injection and compression molded, extruded, thermoformed and heat sealed. The injection molder can start at stock temperatures of 400-450°F., for small items . . . slightly higher for larger ones. In addition, gates and runners for Escon could be of the conventional type, and normal clamp pressures would be employed when molding it. And Escon molds easily—

EXCITING NEW PRODUCTS

ENJAY PLASTICS

ENJAY COMPANY, INC., *15 West 51st Street, New York 19, N.Y.*

EYE WITH NEW BEAUTY AND VERSATILITY

without warpage! Because of its low density, this amazing thermoplastic resin yields more pieces per pound.

For the designer, the high strength of Escon plus its excellent chemical and abrasion resistance allows accurate production of fine and intricate designs with high surface gloss.

And because polypropylene offers greater heat resistance than any other polyolefin, products manufactured from Escon can be readily sterilized by heat or chemical means. *Trademark

Escon can help you make a better product! For technical assistance or to order Escon, contact the nearest Enjay office.

THROUGH PETRO-CHEMISTRY

ENJAY
PLASTICS

Akron • Boston • Charlotte • Chicago • Detroit • Los Angeles • New Orleans • Tulsa • Toronto

This Month In Brief

"Do You Play the Ponies" is the provocative title on a questionnaire recently mailed out to some of our readership in the plastics processing field, and designed to point up any newsworthy trends that would be of interest editorially. The final questionnaire item asks for any comments that would insure the industry's future. The scope of this question is expanded in this month's Editorial to cover our entire readership who is invited to submit their comments and suggestions on the subject to help guide our continuing quest for better and better technical articles and/or stories so that we may better serve you.

The Guest Editorial this month presents a third viewpoint on industrial publicity, and tries to draw a fine distinction between it and technical publicity. While there is some value to this distinction, we frankly don't quite agree with it. Do you?

Some notes on the Technical Articles in this issue are as follows:

The lead article, "Stabilization of Vinyl Copolymer Resins", gives results obtained on vinyl and vinylidene copolymers with different types of stabilizer systems. These results emphasize the need for caution and expert advice by vinyl processors.

"Polyethylene Copolymers" describes the potentials in applications for these materials based on their properties and processing traits.

"Heat-Resistant Encapsulating Resins" discusses heat-resistance values for different types of resin systems, and emphasizes that heat-resistance requirements must be evaluated on the basis of a combination of thermal tests for each system.

"Developments in Vinyl and Related Materials During 1959", the first of the annual series on Advances in the Technology of Plastics, gives a comprehensive literature survey on the subject that will be of utmost value to processors in this field.

Vinyl Extrusion and Volumetric Feeders are the subjects of the engineering section, Exploring Fabrication Techniques, in this issue. The first subject is based on observations made in a recent plant visit. It is noted that favorable vinyl extrusion operations require proper plant set-up and auxiliary equipment, followed by suitable quality control organization. The second subject describes how volumetric feeders can be used to add color to natural PVC in extrusion of wire coverings.

Two Engineering Forum columns this month; Blow Molding, and Injection Molding. The former notes that the blow-molding industry has outgrown available information on plastic materials other than polyethylene. The latter column describes some interesting variations on hot runner molding techniques that insure minimum risk of mold malfunction.

PRODUCT-DESIGN BRIEFS FROM DUREZ

- **Smooth surfaces in metal castings**
- **Plastic in luggage pods**
- **Fast facts on phenolics**

Inside story

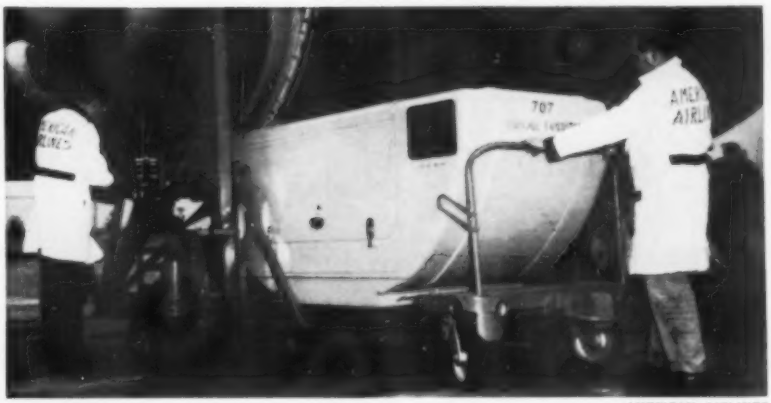
In an engine block such as this one, smoothness of the inner surfaces is a high-priority design problem. Any obstruction or undue roughness in the channels is likely to impede the flow of coolant through the block.

To solve the problem, more and more foundrymen are switching to a method of making castings that gives smooth, clean inner surfaces every time: shell cores.

They're getting more than smoothness. The close tolerances possible with shell cores permit holding section thickness uniform throughout the piece, and from piece to piece. In an engine block, that means better heat transfer.

Finally, most castings made with shell molds and cores need only a bare minimum of machining. That saves money.

Want to know how these better castings are made with the help of Durez foundry resins? Check the coupon and let us send you the new "Durez Guide to Shell Molding."



AMERICAN AIRLINES

It expedites

This pod shrinks time.

For people who have alighted from a jet airliner, it shortens the wait at the luggage checkout.

For the airline, it telescopes flight schedules by cutting ground time to the necessary minimum. For the men who use it to load or unload 35 suitcases at a crack, it takes much of the "lug" out of luggage.

It has to be strong, light in weight, safe. That's why it is made of Hetron® glass-reinforced polyester. Not only does Hetron match and excel the strength characteristics of other reinforced plastics; it is also inherently and *permanently* self-extinguishing. The safety is chemically locked in to stay—not obtained by dilution with additives.

Many great ideas like this one are taking shape in Hetron. They include 65-foot radomes, factory skylights, large boat hulls, outboard motor shrouds, chemical ducts and blowers, transformer housings, heavy-duty switch-gear components.

If you'd like to know more about this versatile, safe material—and who can mold it into shapes for you—check the coupon for the designer's Hetron data file.

At your finger tips

Here's the quickest way we know to compare one phenolic molding material with another. Just send for the new 16-page booklet "Facts on Phenolics." It groups the most popular Durez materials by types (general-purpose, impact, heat-resistant, electrical, etc.). It lists properties of the molding compounds and of molded specimens. It tells which MIL specs a compound is designed to meet. All you do is check the coupon to get a copy free.

For more information on Durez materials mentioned above, check here:

- ☐ Data file on Hetron, including list of fabricators
- ☐ "Durez Guide to Shell Molding" (36-page bulletin)
- ☐ "Facts on phenolics" (16-page booklet)

Clip and mail to us with your name, title, company address. (*When requesting samples, please use business letterhead.*)

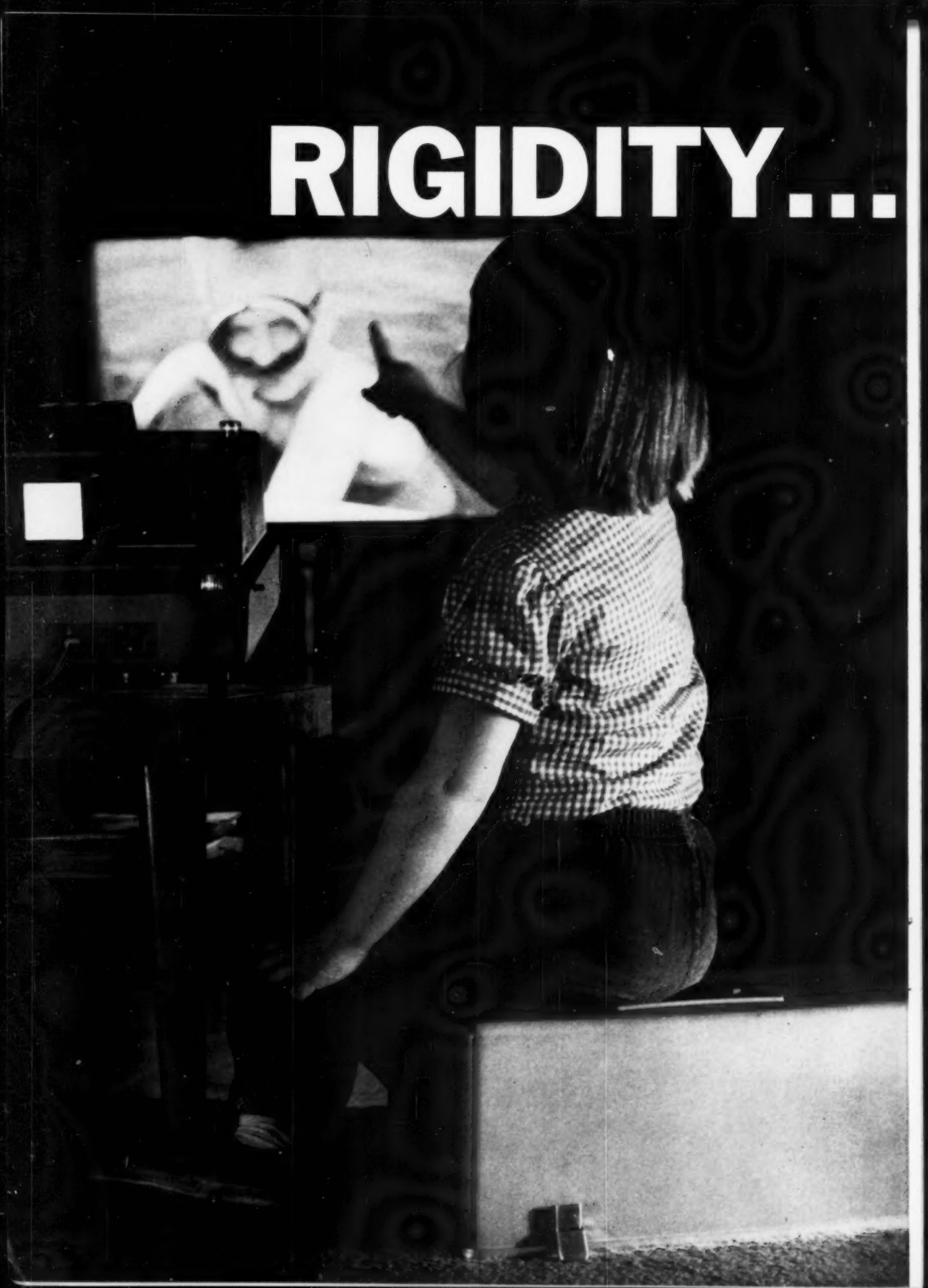
DUREZ PLASTICS DIVISION

8604 WALCK ROAD, NORTH TONAWANDA, N. Y.

HOOKER CHEMICAL CORPORATION

HOOKER CHEMICALS PLASTICS

RIGIDITY...



...another way high-density polyethylene IMPROVES YOUR PRODUCT

STRONG AND RIGID, this "Argus" projector cover is molded of BAKELITE Brand high-density polyethylene copolymer DPDA-7070. While quite large (15"x9"x6½"), it is surprisingly light, thus enhancing the portability of the projector. Molded with an attractive frosty matte finish, this rigid, thin walled carrying case offers protection from abusive treatment as well as constant handling.

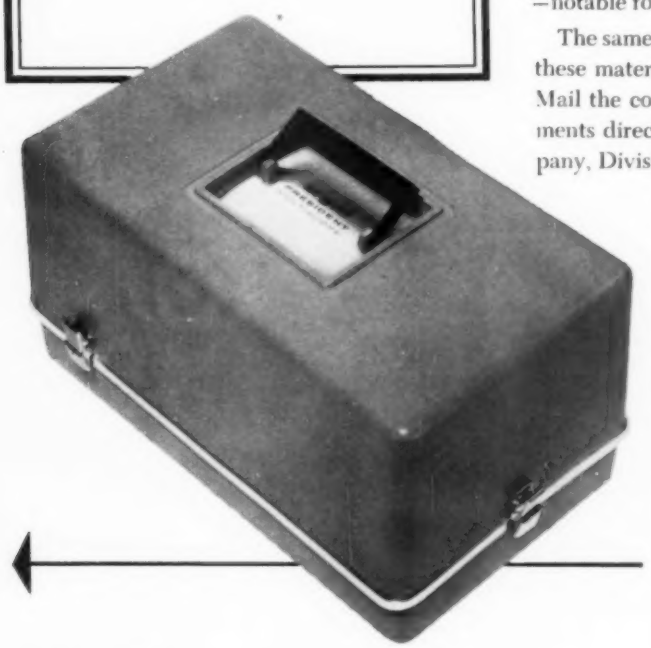
"Argus" found the necessary rigidity combined with extreme toughness in this high-density polyethylene copolymer. If your own product needs this advantage or a combination of others, your search for the right material will be simplified by the variety of BAKELITE Brand polyethylenes. You can select materials on the basis of stress cracking resistance, moldability, dimensional stability, rigidity, strength and other properties.

Every type of polyethylene is available under the BAKELITE Brand. Extending through low, medium, and high densities, the list also includes these remarkable new polyethylene copolymers —notable for toughness, stress cracking resistance, long flex life.

The same technical knowledge and experience that developed these materials is available to help you improve your product. Mail the coupon today, or write a description of your requirements directly to Dept. AA-105, Union Carbide Plastics Company, Division of Union Carbide Corporation, 30 East 42nd St., New York 17, N. Y. *In Canada*, Union Carbide Limited, Toronto 7.

TYPICAL PROPERTIES OF DPDA-7070

	ASTM Test	
Density, gm/cc	D 1505	0.945
Melt Index, gm/10 min.	D 1238	8
No-Load Heat Distortion Temperature		122°C (252°F)
Secant Modulus (Stiffness), psi	D 638	70,000
Tensile Strength, psi	D 638	2,200
Ultimate Elongation, %	D 638	25



argus® "PRESIDENT" PROJECTORS have covers built to withstand abuse—even being drafted occasionally for seating. They're molded of BAKELITE Brand polyethylene copolymer DPDA-7070 by Modern Plastics Corp., Benton Harbor, Mich.

"Bakelite" and "Union Carbide" are registered trade marks of Union Carbide Corporation.

UNION CARBIDE

Dept. AA-105,
Union Carbide Plastics Company
Division of Union Carbide Corporation
30 East 42nd Street, New York 17, N. Y.

Please send me information on BAKELITE Brand high-density polyethylenes with particular emphasis on these properties.....
the application being considered is .....
Name_____
Firm name_____
Street_____
City_____ State_____

What's New in Processing

E. I. du Pont de Nemours & Co. has come up with two processing tips; one for the nylon molder, the other for the laminator. Inherently-slippery nylon becomes self-adhering —temporarily—with a single drop of fluoroalcohol. Acting as a very mild solvent, fluoroalcohol thus prevents molded components of an all-nylon housing from "popping-out" during assembly.

The second processing aid involves the use of poly (dibutyl titanate) to promote adhesion between polyethylene and such dissimilar materials as aluminum foil, Mylar, and cellophane. A pound of the material, commercially available from Du Pont under the tradename Tyzor AC, is sufficient to promote quick, even, tough adhesion of 100,000 square feet of laminate. Its use adds less than 0.004¢ to the cost per square foot. The promoter is said to be superior to esters of orthotitanic acids since its hydrolysis is easier to control. Primed film should be heated to 200-230° F., to avoid later odor development. Polyethylene is extruded at 575-600° F., onto the primed substrate and pressed into place by passage between a pressure and a chill roll.

Anchor Plastics Co. uses two extruders with a common die head to achieve two color effects in custom extrusions. The second color is not a thin veneer, but an integral part of the extrusion several mils thick. Anchor trademarked this line Twin-Tint, and offers it in most thermoplastics. The firm also adapted a metals extrusion technique to plastics—a snap-in trim over a "screwed-in" edging. The base molding is fitted for screws or rivets on the assembly line. Taking advantage of the resiliency properties of butyrate, Anchor has designed an outer, decorative molding to "snap-in" over the base and thus hide the fasteners.

Abstracts

"Bonding and Assembling Rilsan, Polyamide 11" was described by F. Jalenques in the Sept.-Oct., 1959, issue of Industrie Plastiques Modernes. The most suitable bonding agents are listed.

"Synthetic Melt Adhesives" by L. E. Puddefoot ran in the October issue of Plastics Institute Transactions, including synthetic melt cements and high-speed mechanical applicators. The relative merits of melt-reservoir and rod-form types are discussed.

"Solid Blowing Agents for Producing PVC Foams" by G. Wick and P. Schmidt appeared in the August Kunststoffe. The advantages of paste forms were compared with gases, with and without pressure. Products obtained with the pastes are not necessarily inferior in mechanical properties, according to the authors.

Patents

2,884,643 J. Winston—a method of making a vinyl mitten with elastic at the wrist. Here, the vinyl is shirred with rubber elastic tape, which is secured in stretched condition by a heat sealed vinyl strip.

2,883,233 Benton Beckley—a process for molding a reinforced-plastic house trailer in two halves.

2,879,918 A. Root to Bradley Container Corp.—a method of completing a thermoplastic container blank. The interior is pretreated to make it receptive to coating, except in the area adjacent to the open end which is to be heat-sealed.

2,883,315 P. Palmquist to Minnesota Mining & Mfg. Co.—a method of making a surface-decorated, flexible plastic sheet assembly. The plastic is solidified on an inextensible, flexible carrier sheet having free ends. There are no interlocking bonds, and the carrier sheet serves to prevent distortion during decoration.

2,884,328 E. Johnson to Union Carbide Corp.—a method for obtaining a tight over wrap on a food item. Stretch is applied to the thermoplastic film having a normal perimeter smaller than the item to be packaged. When greater than the item, the stretch stress is released at a faster rate than the rate of contraction.

getting good reception
in community TV...

Mohawk's H-F coaxials, jacketed and insulated with TENITE POLYETHYLENE

For community television distributing systems in any area, Mohawk H-F coaxials do a complete transmission job, from tower or relay station right into the living room.

Tenite Polyethylene is used as jacketing and insulating material on these cables. It offers all-round high performance which gives them long life, keeps line loss low, and permits ease in installation.

As a jacketing material, tough Tenite Polyethylene provides excellent resistance to abrasion, weathering, moisture, and heat. Users can look forward to years of maximum protection.

As an insulating material, Tenite Polyethylene has a low power factor, which holds energy losses to a minimum. In these Mohawk cables, both solid and foamed Tenite Polyethylene are used for primary insulation... the foamed material having an even lower djelectric constant than the solid, thus making possible a thinner insulation with a resulting decrease in cable weight.

Linemen find that cable jacketed with lightweight Tenite Polyethylene is easy to handle and strip and is flexible even at sub-zero temperatures.

There is a formulation of Tenite Polyethylene to meet the demands of most insulating and jacketing applications. For further information on this useful plastic, write EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENNESSEE.

● *Both natural and black electrical grade Tenite Polyethylene are available to cable manufacturers as unique spherical pellets which flow freely in the extrusion process and in "air-veying" bulk shipments from truck to bin.*

● *Cable manufactured by Mohawk Wire & Cable Corporation, 320 River Street, Fitchburg, Massachusetts. Jacketing and insulation extruded of Tenite Polyethylene.*

TENITE®
POLYETHYLENE
an Eastman plastic

Leading roll in resin performance

Layup time is reduced, wasteful flooding eliminated, production rates increased.

Faster wetting, rapid curing GLIDPOL layup resins make these dramatic savings possible wherever they are used in the reinforcement of plastic parts.

GLIDPOL layup resin systems are ideally suited to the manufacture of boats, bathtubs, sinks, swimming pools, truck bodies, panels, tanks and other products by the hand layup technique. Write for complete information on the resin system best designed to meet your particular requirements.

QUALITY Glidden PRODUCTS

RESINS FOR EVERY APPLICATION

The Glidden Company
INDUSTRIAL PAINT DIVISION
900 Union Commerce Building • Cleveland 14, Ohio
In Canada: The Glidden Company, Ltd., Toronto, Ontario

There's a GLIDPOL Polyester Resin system, plus Glidden Technical Service, to help you do it better, more economically, whatever your product, process or problem.

EDITORIAL:

"Do You Play the Ponies?"

A questionnaire recently mailed out to a representative nationwide sampling of our readership in the plastics processing field bore the questioning title, "Do You Play the Ponies?" Replies to the questionnaire will provide a picture of the average processing reader, his interests both at work and away from work (even horse playing, hence the catchy title), his activities for his company, and the nature of his company's business.

Speaking from the editorial viewpoint, the questionnaire is designed to point up any trends in the plastics processing field—trends that are already in existence, as well as those that will soon become evident.

•

While most of the questions asked require only fill-in replies, the final question is marked optional and requires a more lengthy reply. The reader is asked for any comments he may have on what is most needed by the industry to assure its future (and also his own). It is noted that this could include needs in materials, equipment, processing techniques, government regulations, etc. In fact, this question offers the reader an opportunity to express his own opinions on the subjects he believes most important for the future growth of the field.

The importance of this question is such that we would like to enlarge on the questionnaire's scope and ask our entire readership for their comments or opinions on what is most needed by the plastics industry. This question is deliberately left wide open—we are interested in receiving all your comments, whether opinions, suggestions, ideas, compliments, complaints, or what have you.

Comments from our general readership on this question will give us the needed ammunition in our continuing quest for ever-improving technical articles and or stories for the magazine in order that we may better serve all the readers.

As we have mentioned previously, we consider "stillness just another aspect of death." Also, we cannot claim perfection for this magazine—nothing born of man can ever be perfect as such. Consequently, this editorial is written to stimulate a response from you to help direct our goals in the direction that would be most beneficial to you and the industry in general.

•

Summing up, we can reiterate two points, as follows:

(1). If you received the questionnaire but have not replied to it as yet, please do so as soon as possible.

(2). For our entire readership, please let us have your thoughts on what the industry needs most badly, and what we can do to further improve this magazine.

May we hear from all of you?

Arthur M. Merrill
Editor

Subject: **POLYMERIC PLASTICIZERS**

Object: **COMPARE BENEFITS OF SANTICIZER® 409**

(permanence, processing ease, and cost)

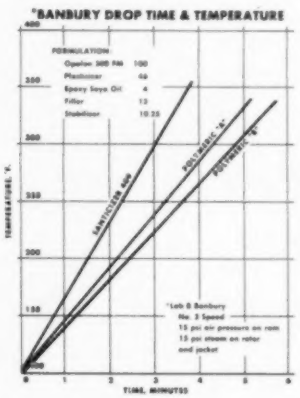
IMPROVED PERMANENCE

SANTICIZER 409 is highly compatible and imparts good performance properties to vinyls. Volatility is low. Heat stability and light stability are excellent. Comparative tests show that SANTICIZER 409 resists solvent extraction best of all lower-cost polymeric plasticizers. SANTICIZER 409 *stays put*, won't exude even in high humidity.

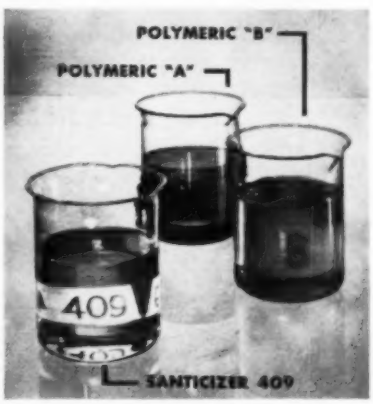
FASTER PROCESSING

SANTICIZER 409 has low viscosity, high solvency . . . for much faster fusion and extrusion. Helps prevent pinholes, "fisheyes," and roughness. You can count on SANTICIZER 409 to boost output, reduce processing problems, and assure optimum physical properties *within your processing-temperature range.*

FAST FUSION



OPTIMUM CLARITY



HIGH PURITY

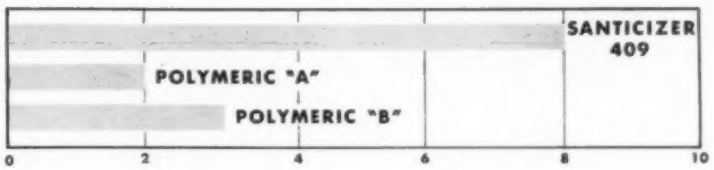
SANTICIZER 409 is clear, non-hazy, light-colored. Contains no flocculent matter that might weaken electrical properties or cause spotting in thin films and transparent sheeting. SANTICIZER 409 adds no odor to gaskets or wire insulation for refrigerators or other low-odor applications.

SUBSTANTIAL SAVINGS

Compare prices and specific gravities. SANTICIZER 409 gives compounders more plasticizer per dollar . . . *more profit per unit volume of compound.* And easier, quicker processing provides added savings.

WEEKS TO EXUDE AT 100% HUMIDITY, 60°C

HIGHER COMPATIBILITY



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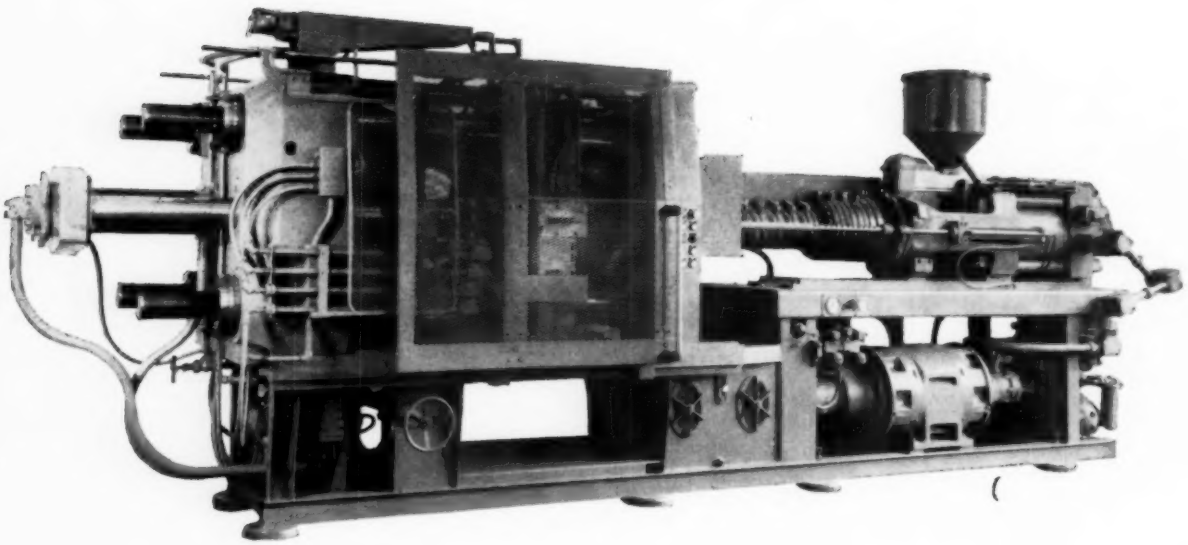

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In the process of permeation—involving solution of the gas in the barrier material, diffusion through the barrier, and escape as a gas from the opposite side—permeability (rate of gas passage through a barrier of unit thickness) is a function of the diffusion rate and solubility of the gas in the barrier. Variables which affect permeability include temperature of the system, composition of the barrier, and size, shape and configuration of both the barrier molecules and gas molecules.

The general equation for gas transmission through a barrier is:

$$R = \frac{\overline{P} A \Delta p}{d}$$

where R = Maximum allowable gas transmission
$\overline{P}$ = Coefficient of gas transmission
A = Transmission area
Δp = Pressure differential across barrier
d = Thickness of barrier

This equation may be used to specify or evaluate the degree of resistance to gas passage obtained from a plastic material. However, $\overline{P}$ of the material must be measured experimentally. For example, $\overline{P}$ data for Saran Wrap* 7 and for Dow Polyethylene 610M are plotted on the basis of

$$\frac{\text{cc} - \text{mil}}{100 \text{ in.}^2 - 24 \text{ hrs.} - \text{atm.}}$$

in Figure 2.

Different sets of units are found in existing literature on permeability, and Figure 1 provides conversion factors for reducing the various units to common values.

Continuing Plastiatrics studies by Dow Plastics Technical Service Engineers are constantly developing new data on gas permeability of Dow packaging and molding material. For further information on these studies, write THE DOW CHEMICAL COMPANY, Midland, Michigan, Plastics Sales Department 1800DT4.

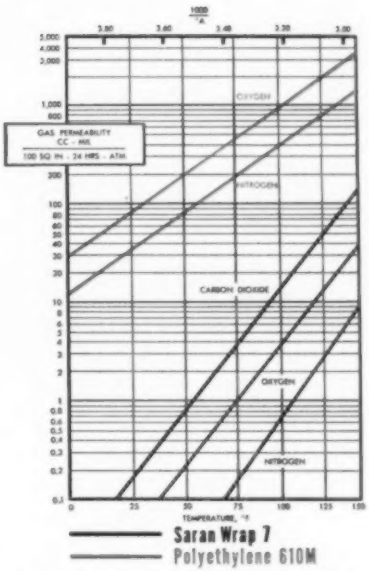

Fig. 2 Coefficients of Gas Transmission of Saran Wrap 7 and Polyethylene 610M, for various gases and temperatures.

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Fig. 1 Conversion factors for reducing permeability units to common values.

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TO OBTAIN	$\frac{\text{cc-mm}}{\text{m}^2\text{-sec-cm Hg}}$	$\frac{\text{cc-mm}}{\text{m}^2\text{-sec-atm}}$	$\frac{\text{cc-mm}}{\text{m}^2\text{-24 hr-atm}}$	$\frac{\text{cc-mil}}{100\ \text{in}^2\text{-24 hr-atm}}$	$\frac{\text{cc-mil}}{\text{m}^2\text{-24 hr-atm}}$	$\frac{\text{cu in-mil}}{100\ \text{in}^2\text{-24 hr-atm}}$
$\frac{\text{cc-mm}}{\text{m}^2\text{-sec-cm Hg}}$	1.0	1.32×10^{-2}	1.52×10^{-7}	6.00×10^{-9}	3.87×10^{-9}	0.98×10^{-6}
$\frac{\text{cc-mm}}{\text{m}^2\text{-sec-atm}}$	76.0	1.0	1.16×10^{-5}	4.56×10^{-7}	2.94×10^{-7}	7.47×10^{-5}
$\frac{\text{cc-mm}}{\text{m}^2\text{-24 hr-atm}}$	6.57×10^{6}	8.64×10^{4}	1.0	0.39	2.54×10^{-2}	6.45
$\frac{\text{cc-mil}}{100\ \text{in}^2\text{-24 hr-atm}}$	1.67×10^{7}	2.19×10^{5}	2.54	1.0	6.45×10^{-2}	16.4
$\frac{\text{cc-mil}}{\text{m}^2\text{-24 hr-atm}}$	2.58×10^{8}	3.40×10^{6}	39.4	15.5	1.0	2.54×10^{2}
$\frac{\text{cu in-mil}}{100\ \text{in}^2\text{-24 hr-atm}}$	1.02×10^{8}	1.34×10^{6}	0.16	6.10×10^{-3}	3.94×10^{-3}	1.0

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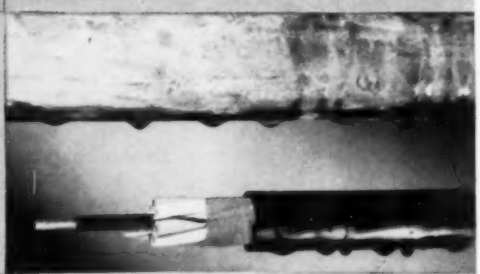

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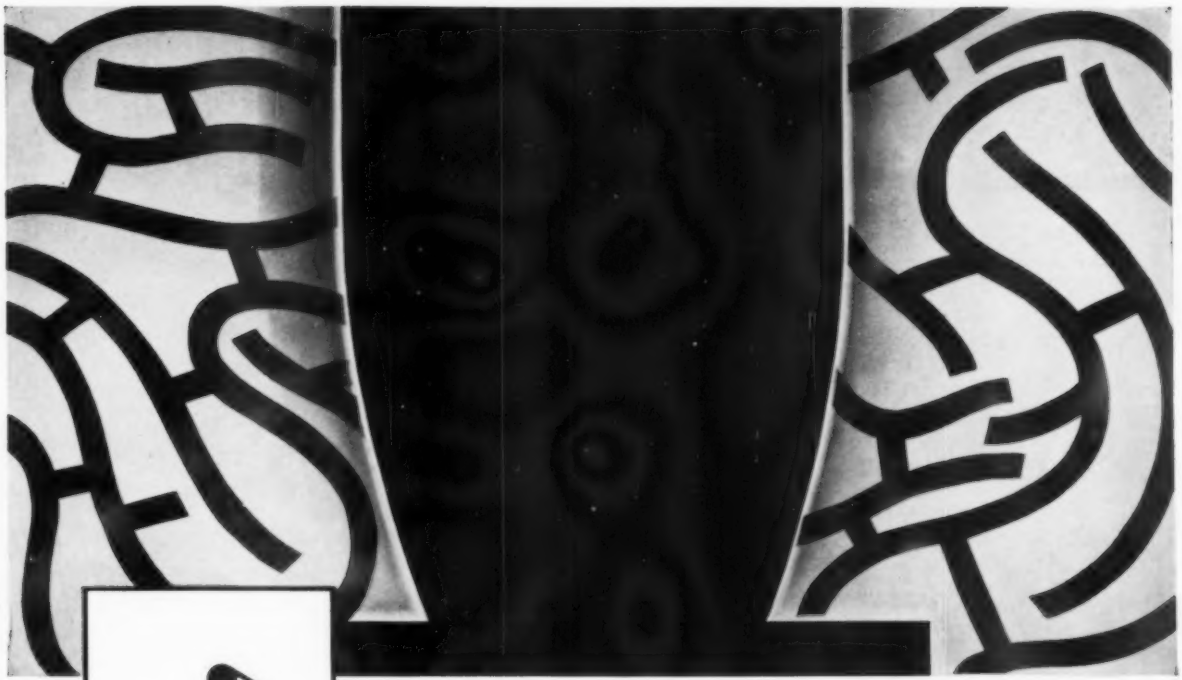

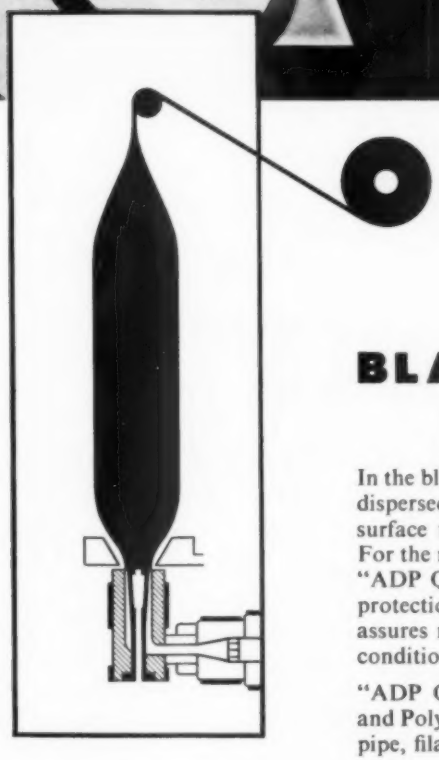

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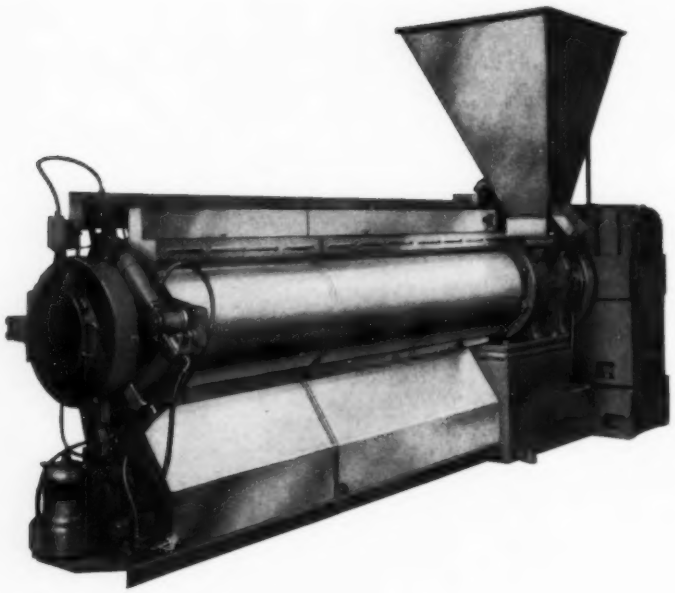

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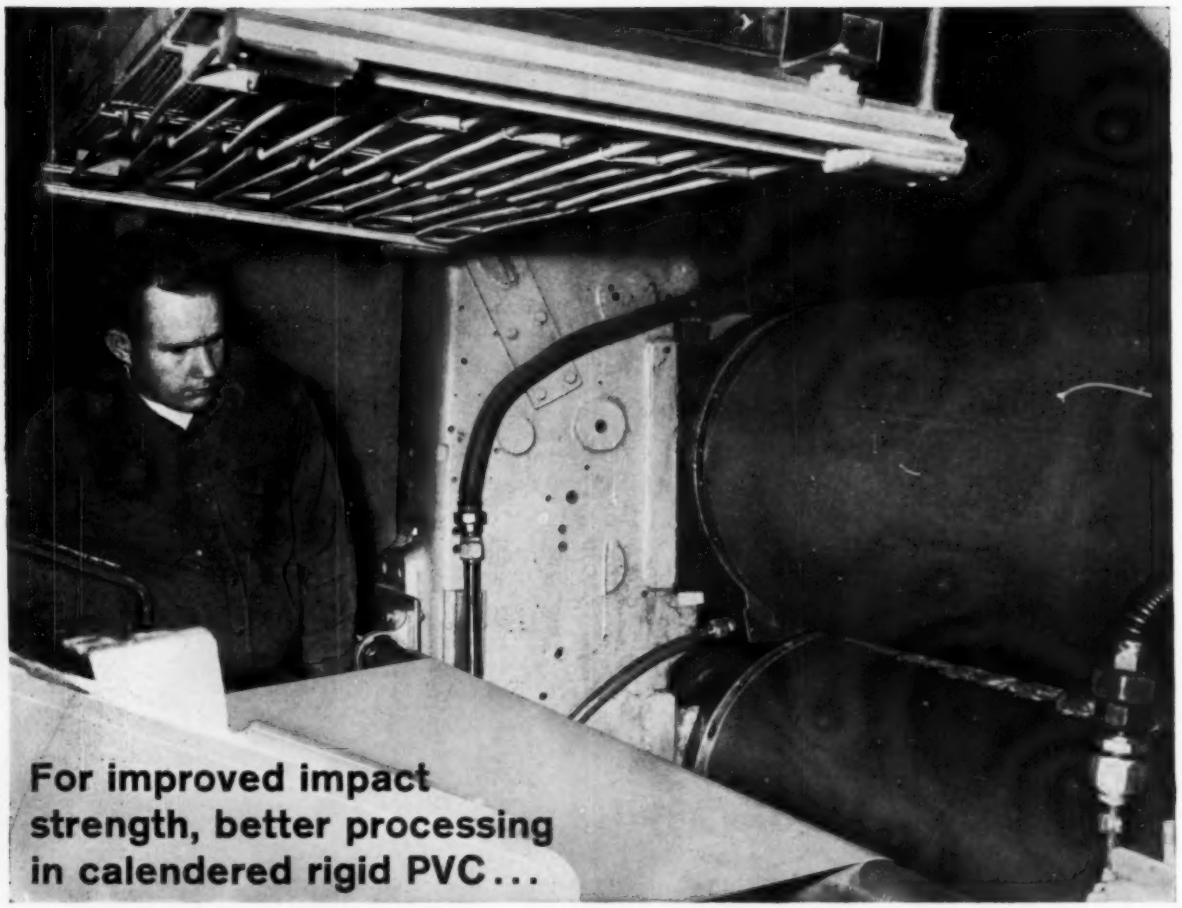

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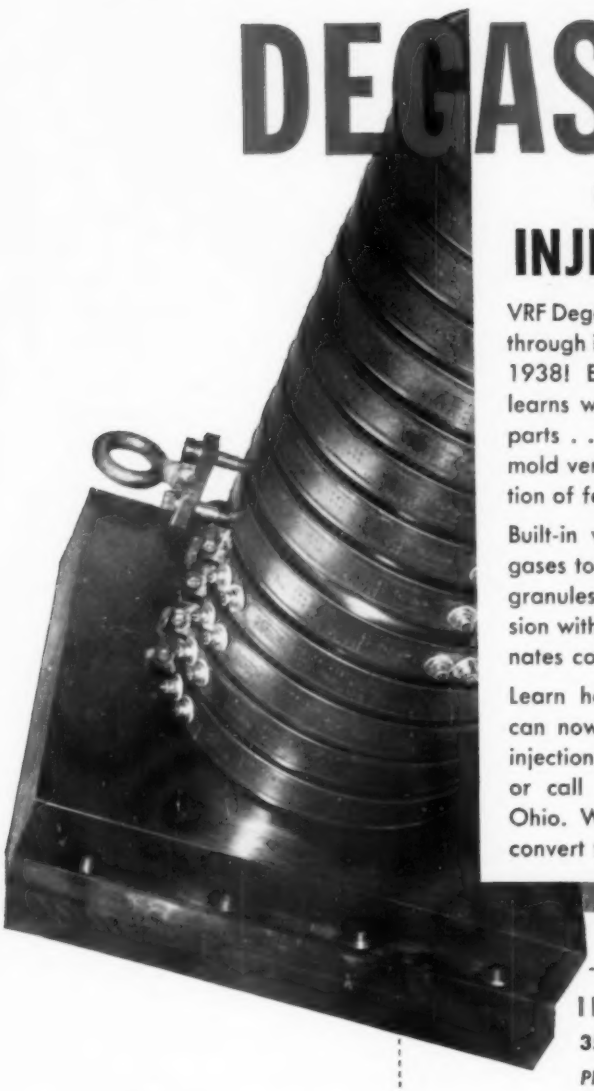

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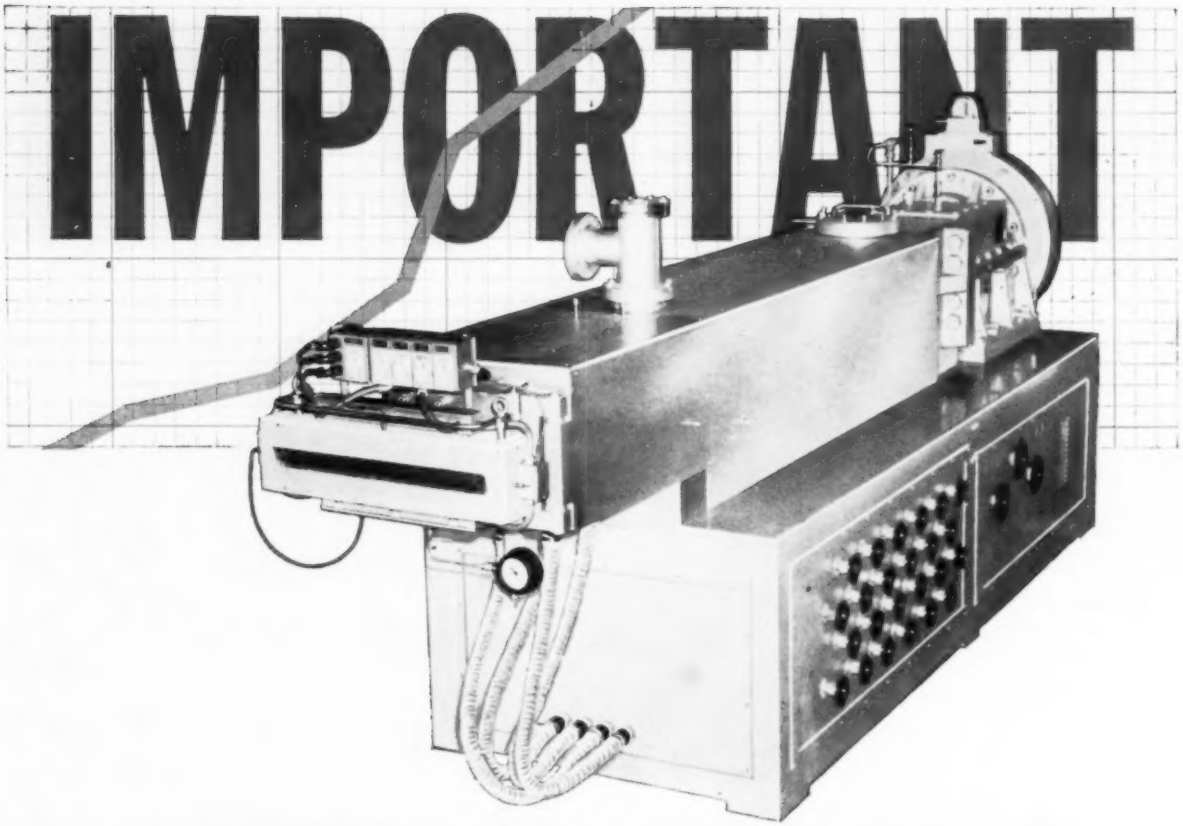

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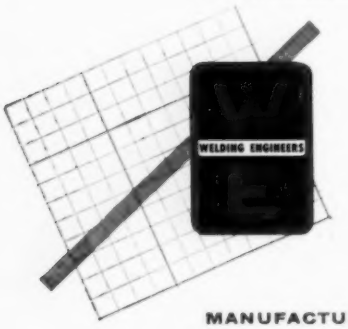

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PLASTICS
THE MAGAZINE OF APPLIED ENGINEERING
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Stabilization of vinyl copolymer resins

Test results for various resin types and four stabilizer systems.

D. G. KNOWLES, Product Mgr.—
Vinyl Stabilizers
The Harshaw Chemical Co.
Cleveland, Ohio

POLYVINYL CHLORIDE (PVC) was first prepared in the nineteenth century, but commercial utilization came much later. PVC is a hard, horny, chemical-resistant, insoluble, heat-unstable thermoplastic with a softening temperature in the range of 200° F., and a processing temperature of about 350° F. (varies with molecular weight). It is very difficult to process. Practical commercial usage was not realized until softer and/or more soluble vinyl copolymer resins, adequate plasticizers, and effective heat and light stabilizers were developed.

Vinyl copolymers probably were first developed to improve solubility for ease of processing in solution form. It was then found that many of these copolymers had lower softening and processing temperatures, were softer than PVC, and possessed other modified properties.

A wide variety of vinyl copolymer resins can be prepared with two or more monomers of which vinyl chloride is the principal component, but only a few of the possible copolymers are commercially available. The degree and type of variation from PVC will vary with the monomers and ratios used. Many properties are affected in either direction.

Vinyl acetate (3-20%) copolymers provide lower softening temperatures (140° F.), lower chemical resistance, increased solubility, greater permeability, increased flexibility, reduced plate-out, improved dimensional stability, lower water absorption, and improved adhesion to metal when heated. Controlled hydrolysis permits controlled placement of the hydroxyl group in the polymer for improved adhesion to paints, cellulosics, etc., and allows cross-linking with phenolics, ureas, epoxies, etc.

The introduction of carbonyl terpolymer groups, as with maleic anhydride, promotes adhesion to glass, metal, etc. These properties have led to wide usage in solutions, compounds for phonograph records, and vinyl-asbestos flooring; some usage in calendering, extrusion, and plastisols. Vinylidene chloride copolymers contribute lower vapor permeability; better oil, grease, and solvent resistance; and much less plate-out than does PVC. These resins are used in calendering, extrusion, plastisols, and baked coatings.

The stabilization of these two vinyl copolymers has been studied in comparison with PVC, and is reported in this paper. A simple, high-resin content, DOP-plasticized formulation was used to emphasize resin effects. Four resins were studied—two different grades of PVC, and representative resins of vinyl acetate and vinylidene chloride copolymers. The use of fillers and other plasticizers will affect stabilization.

It has been said that some vinyl copolymers actually require less stabilization than does PVC. Although many vinyl copolymers will permit processing from solution and at lower processing temperatures, therefore requiring less heat-stabilization, it also is true that when processed at equal temperatures, vinyl acetate and vinylidene

Donald G. Knowles was born in Pittsburgh, Pa., in 1928. He received a B.A. in Chemistry in 1950 from Upsala College, and a B.S. in Chemistry in 1951 from Newark College of Engineering. Entering industry after college, he worked for Goodyear Tire & Rubber Co. from 1951-1954, doing plastisol development and service for the company's Chemical Development Department. He transferred to The Harshaw Chemical Co. in 1954, doing technical sales on vinyl stabilizers from 1954-1957. Since 1957, he has been Sales Manager and also Product Manager—Vinyl Stabilizers for Harshaw. He is a member of ACS, SPE, and Tau Beta Pi. His major hobbies are boating and hunting.

Mr. & Mrs. Knowles and their three children make their home in Garfield Heights, Ohio.

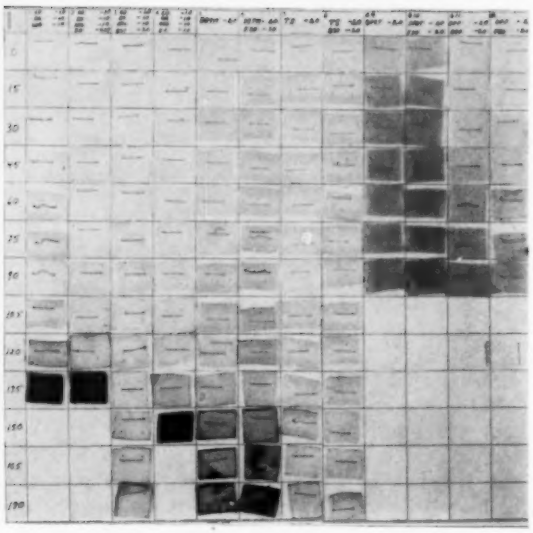

Fig. 1. Test results with oven aging at 350° F. for lead-stabilized PVC-1 formulations containing 20 parts DOP plasticizer.

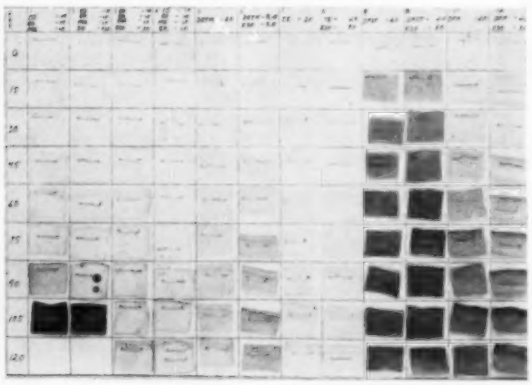

Fig. 2. Test results with oven aging at 350° F. for lead-stabilized PVC-2 formulations containing 20 parts DOP plasticizer.

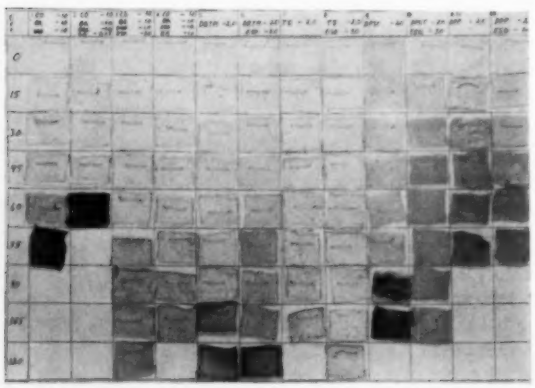

Fig. 3. Test results with oven aging at 350° F. for lead-stabilized vinyl chloride vinylidine chloride copolymer formulations containing 20 parts DOP plasticizer.

chloride copolymers not only are less stable, but different in stabilizer response, than is PVC. However, PVC resins themselves will vary considerably from one grade to another with regard to heat stability and response to different types of stabilizers (presumably due to different catalysts, molecular weight, purity, etc.). These same variables will occur in copolymers.

Test Program

There are four groups of stabilizers commonly used in the U.S.A. Since there are many individual stabilizers in each group, representative materials were selected from each. These groups and materials are as follows:

(1). Barium-Cadmiums. The barium-cadmium vinyl stabilizers perhaps are the most varied, versatile, and widely-used group. They consist primarily of barium, cadmium, zinc, and calcium salts, and soaps with assorted phosphites and antioxidants. Individual 15% cadmium, 21% barium, and 8% zinc soaps and a commercially-available mixed phosphite were used in this study to determine relative effects in the different resins, and to facilitate ratio variations.

(2). Basic Lead Compounds. Many are used as vinyl stabilizers. Dibasic lead stearate and dibasic lead phosphite were selected for comparative tests here.

(3). Tin Compounds. Broadly speaking, there are two types of tin stabilizers used in vinyls: dibutyl tin salts or soaps; and various organo tin mercaptide compounds. Di-butyl tin maleate and a commercially-available tin mercaptide were chosen for this study.

(4). Epoxy Compounds. There are three types of epoxy compounds used for the stabilization and plasticization of vinyl resins: epoxy resins; epoxidized soybean oils; and epoxidized alkyl esters. An epichlorhydrine-bisphenol condensation epoxy resin and epoxidized soybean oil were evaluated for this paper at about equal cost.

Representative systems based on the selected barium-cadmium lead and tin stabilizers were first run in the four resins, both with and without epoxidized soybean oil (see Figures 1-4). The epoxy resin was compared to epoxidized soybean oil with the barium-cadmium-phosphite system only. No effort was made to use the barium-cadmium, lead, and tin stabilizers at equal cost or efficiency, since the object of this work was to evaluate relative performance of the different groups of stabilizers in vinyl acetate and vinylidene chloride copolymers compared with PVC.

The tests were run by preparing dry-blends of all ingredients; milling for 10 minutes on a two-roll, 6-by 12-inch, differential-speed mill at 310° F.; and oven-aging at 350° F. Samples were taken every 15 minutes until significant color degradation occurred.

Test Results

Four barium cadmium systems are shown in Figures 1, 2, 3, and 4—the fundamental barium, cadmium, and phosphite alone; with zinc; and with the two different types of epoxy materials. PVC-2 provides about 25% less (vinyl acetate and vinylidene chloride copolymers about 50% less) heat stability than does PVC-1. The zinc response of these copolymers, in the

content used here, is poor with no improvement in early color and a loss in ultimate heat stability. In PVC, however, zinc improves color with no loss of heat stability. This zinc response will vary with the barium/cadmium/zinc ratio. The use of epoxy is very beneficial in these copolymers and in PVC-1. Epoxidized soybean oil gives better results than the epoxy resin. PVC-2 does not respond as well to epoxy as do the other resins, but epoxy resin works better than epoxidized soybean oil. The vinylidene chloride copolymer provides better ultimate heat stability, but worse early color than does the vinyl acetate copolymer.

Ratio and stabilizer content were evaluated in these copolymers with the barium-cadmium family (see Figures 6 and 7). All of these tests include epoxidized soybean oil.

With the vinylidene chloride copolymer, an increase in barium content from a ratio of 1.4 barium/1.0 cadmium to 2.0 barium/1.0 cadmium (as metal) increases heat stability. A further increase in barium to a ratio of 6 barium/1 cadmium provides very poor early color. Increasing the cadmium content to a ratio of about 1.0 barium/1.0 cadmium improves early color very slightly, but there is a significant loss in ultimate heat stability. A minimum phosphite content is required. The addition of a very small amount of zinc with a high barium content improves early color slightly. An increase in epoxy content improves over-all performance substantially.

In the vinyl acetate copolymer, the same response was obtained as with the vinylidene chloride copolymer in regard to barium/cadmium ratio variation and epoxy content. However, phosphite content is much less critical and zinc response is worse with the vinylidene chloride copolymer than with the vinyl acetate copolymer.

Four lead stabilizer systems were run in Figures 1-4, using dibasic lead stearate and dibasic lead phosphite both with and without epoxidized soybean oil. The vinyl acetate and vinylidene chloride copolymers respond better to dibasic lead stearate than does PVC-1, which responds better than PVC-2. The use of epoxidized soybean oil with dibasic lead stearate in copolymers contributes to poor early color, but improves ultimate heat stability. However, this epoxy detracts from color throughout the heat-age cycle in PVC.

The vinyl acetate copolymer and PVC-1 respond better to dibasic lead phosphite than does PVC-2, which responds better than the vinylidene chloride copolymer. Epoxidized soybean oil improves performance considerably in the vinyl acetate copolymer and in both PVC's, but only slightly in the vinylidene chloride copolymer.

The two tin stabilizers selected for this study are shown in Figures 1-4, both with and without epoxidized soybean oil. The copolymer resins respond better to dibutyl tin maleate for early color, but provide about 30% less ultimate heat stability than does PVC. The use of epoxidized soybean oil is deleterious to color and stability in all resins except the vinyl acetate copolymer in which the ultimate heat-stability is improved slightly.

The copolymer resins are about 40% less stable with the tin mercaptide stabilizer than are either PVC resins.

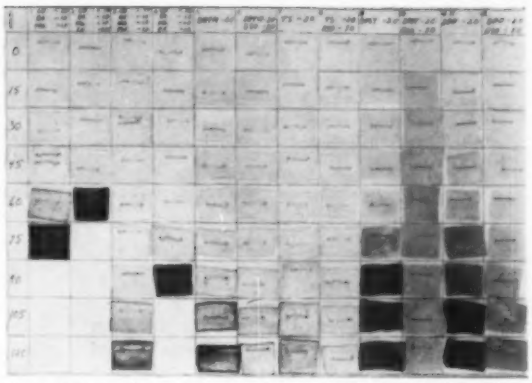

Fig. 4. Test results with oven aging at 350° F. for lead-stabilized vinyl chloride-vinyl acetate copolymer formulations containing 20 parts DOP plasticizer.

The vinylidene chloride copolymer responds slightly better than the vinyl acetate copolymer. The copolymers respond to epoxidized soybean oil, but PVC resins do not.

The use of epoxidized soybean oil with tin stabilizers in these tests is not meant to suggest that these combinations be used in actual practice, in view of incompata-

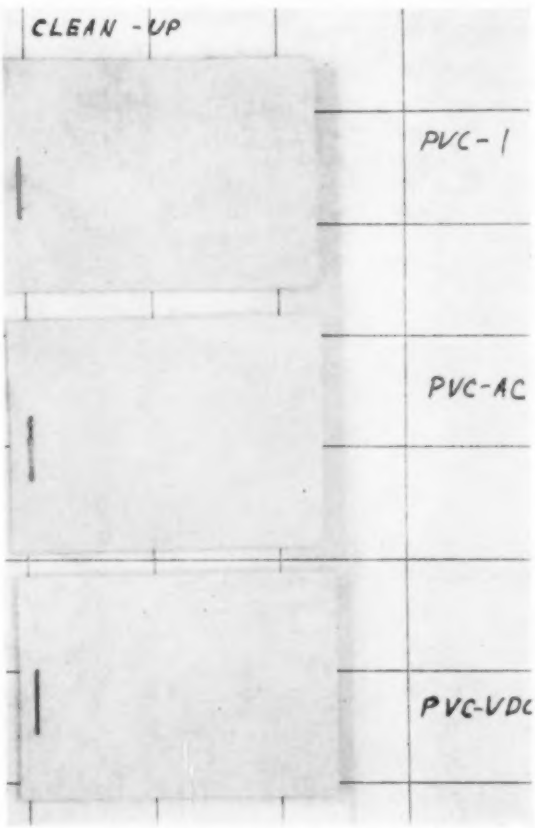

Fig. 5. Results of plate-out tests after milling at 310° F. of PVC, vinyl chloride-vinyl acetate copolymer (PVC-AC), and vinyl chloride-vinylidine chloride copolymer (PVC-VDC) formulations contained 100 parts resin, 45 parts DOP, five parts epoxidized soybean oil, 4.0 parts red paste pigment, and 2.5 parts barium-cadmium-zinc stabilizer.

bility which has been reported.

The effects of epoxidized soybean oil compared to an epoxy resin have been discussed in conjunction with metallic constituents. Epoxidized soybean oil is effective in all cases with the barium-cadmium systems, and perhaps is of greater value in the copolymers than in PVC. Variable and questionable performance is obtained using lead and tin stabilizers. At equal cost, epoxidized soybean oil usually performs better than the epoxy resin.

Figure 5 demonstrates the differences in plate-out which can be obtained using copolymer resins as compared with PVC. The tests were run by two-roll milling a formulation containing the test resin, DOP, epoxidized soybean oil, a permanent 2B BON red pigment, and a barium-cadmium-zinc stabilizer at 310° F. for 10 minutes. This batch was then removed from the mill and followed by a white clean-up batch to pick up the red plate-out on the rolls. These clean-up batches shown in Figure 5 demonstrate that the vinylidene chloride copolymer is the best by far in non-plate-out, followed by the vinyl acetate copolymer, with PVC-1 a close third.

This study cannot be all-inclusive because of the wide variety of stabilizing agents available in each of the three principal metallic groups and other possible formulation variations. Also, stabilizer requirements other than heat-stability and color (such as odor, toxicity, sulfur-stain resistance, plastisol viscosity, and air release), plus the ever-present factor of cost, must be considered. Caution is suggested, although some generalizations can be made to assist the vinyl processor in working with these copolymers.

When using a vinyl chloride-vinylidene chloride copolymer, a 2:1 ratio of barium:cadmium (as metal) system with one phr. phosphite, about six phr. epoxidized soybean oil, and very little or no zinc should be prepared. Dibasic lead stearate, with epoxy (if ultimate heat stability is more important than early color) and a tin mercaptide stabilizer should then be compared to the barium-cadmium system.

On the other hand, a 2:1 ratio of barium to cadmium (as metal) with 0.5 phr. or less phosphite, six phr. epoxidized soybean oil, and no zinc is indicated for vinyl chlorine-vinyl acetate copolymers. Comparisons should be made at equal cost, with dibasic lead phosphite for early color, and with dibasic lead stearate for ultimate heat stability—both with epoxidized soybean oil. Again, tin mercaptide would be the preferred tin stabilizer.

The progress made by stabilizer suppliers, the increased complexity and multiplicity of stabilizers of all types, and the existing interest in "package" barium-cadmium-zinc-phosphite stabilizers makes an exhaustive stabilizer study almost impossible for most vinyl processors. The optimum stabilization system can best be developed using actual production formulations with maximum cooperation between the vinyl processor and his suppliers.

Conclusions

The development of vinyl copolymers was a big factor in the commercialization of vinyl resins. These copolymers offer many modified properties. Vinyl acetate and vinylidene chloride are two of the more widely-used copolymers, and were selected for heat stabilization studies.

Vinyl chloride-vinyl acetate and vinyl chloride-vinylidene chloride copolymers, and different grades of vinyl chloride polymers exhibit varied response to typical barium-cadmium, lead, tin, and epoxy stabilizers. The results would suggest caution in working with different vinyl and copolymer resins.

The increasing complexity of vinyl stabilization necessitates close cooperation between vinyl processors and stabilizer suppliers to obtain the most effective and economical results.

(Continued on page 42)

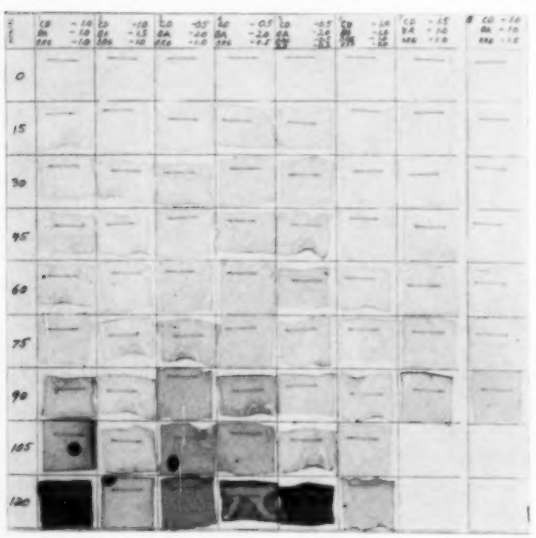

Fig. 6. Test results with oven aging at 350° F. for vinyl chloride-vinyl acetate formulations containing 20 parts DOP plasticizer, 3.0 parts epoxidized soybean oil, and various barium-cadmium stabilizers.

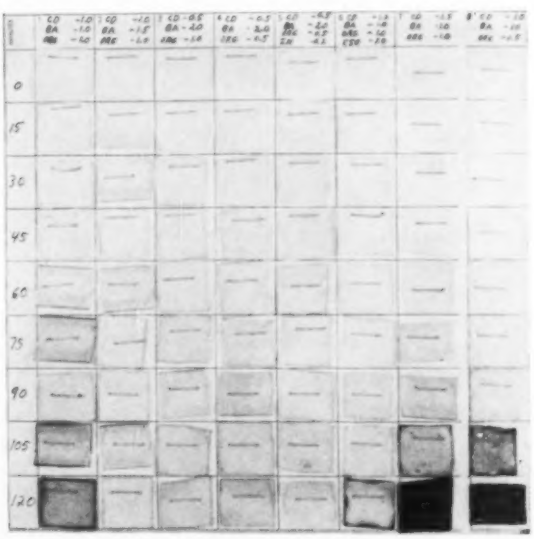

Fig. 7. Test results with oven aging at 350° F. for vinyl chloride-vinylidine chloride formulations containing 20 parts DOP plasticizer, 3.0 parts epoxidized soybean oil, and various barium-cadmium stabilizers.

Polyethylene copolymers

Chemistry, properties, processing traits, and suggested fields of application for these new olefin resins.

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A NUMBER of polyolefin resins have been introduced of late. These materials are copolymers of ethylene with other olefins, and are offered in a range of densities and melt indexes. This paper outlines their basic physical properties, relating them to specific end-uses. Consideration is given to extruded, blow molded, and injection molded applications. Answers to the questions of "why" and "where" to use copolymers will give us a logical approach.

To establish the relationship of these new materials to the polyethylene family, let us first consider their molecular structure. Two of the primary means of classifying a polyethylene resin are crystallinity and molecular weight. Crystallinity is a measure of the degree of branching in polyethylene, while molecular weight is a measure of the chain length.

For further clarification of crystallinity, let us review a diagram of the molecular structure of polyethylene. Figure 1 depicts the arrangement of branched and linear material. The branches prevent the chains from being packed together and, therefore, serve to control the density. The reduced branching of linear polyethylene yields higher crystallinity. From this, it is easy to see how resins of minimum branching can be packed closer together to yield higher densities.

Crystallinity values and molecular weights of various polyethylene greases, waxes, and the commonly-known molding materials are shown in Figure 2. The molding resins are divided into the standard groups of low-density or Fawcett Types, medium-density or Modified Fawcett, and high-density or Linear Types. The density range covered for these three types is from 0.918 to 0.965, and the molecular-weight range is from approximately 12,000 to about 120,000. Crystallinity values for the molding group range from 50% to 96%.

Our discussion thus far has been directed to the polyethylene homopolymer family; i.e., to resins produced by various techniques from a single olefin—ethylene. The new polyolefins (polyethylene copolymers) also conform to this basic relationship of crystallinity or density and molecular weight. Table 1 lists several members of the polyolefin family and their corresponding density and crystallinity values. The high-density polyethylene homopolymers are depicted as Fortiflex A, representing the Phillips type, as a Ziegler High-Density. Fortiflex B50 and B45 represents polyethylene copolymers, and the regular branched-resin is conventional polyethylene. The density of each resin is the key to the crystallinity and/or branching. (It is understood, of course, that some modification can be made in the crystallinity of a material by quench or annealing techniques.) The material listed as Fortiflex B45 is a 0.945 density polyethylene copolymer, and has a density and crystallinity comparable to a Ziegler-type polyethylene homopolymer.

Let us now review the effect of changes in the two polyethylene controls mentioned earlier, crystallinity and molecular weight. Basically, all properties of a resin in this family are influenced by these two factors. Tables 2 and 3 show the general relationships which occur in the polyethylene resin family when we vary these parameters of crystallinity and molecular weight. These property relationships apply to both homopolymer and copolymer.

We will now review the changes that occur through the density range of 0.960-0.945. Table 2 lists the properties that depend on density and the resultant change in value. Such factors as hardness, heat distortion, and tensile strength undergo slight change, while environmental stress-crack resistance, stiffness, and molding characteristics are affected to a greater degree.

Table 3 gives property changes of the homopolymer and copolymer dependent on melt index which, in turn, is dependent on molecular weight and varies as

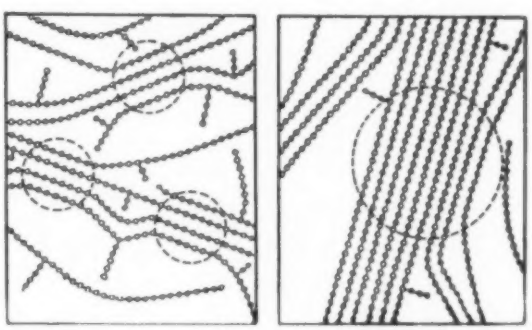
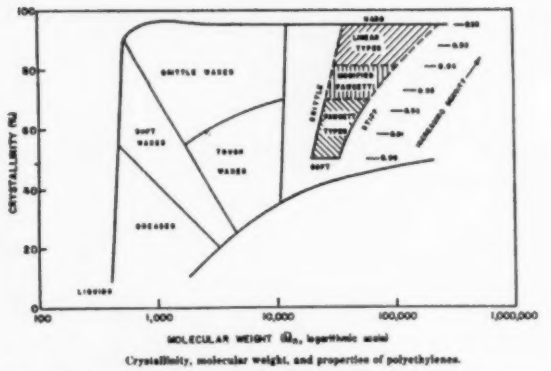


Fig. 1. Graphic views of branched polyethylene (left) and linear polyethylene (right). (Taken from "Linear Polyethylene and Polypropylene: Problems and Opportunities," p. 13, Polymer Associates, Kansas City, Mo.,) 1958.



Crystallinity, molecular weight, and properties of polyethylenes.

Fig. 2. Relationship of polyolefins with greases and waxes with respect to crystallinity, molecular weight, and density. (Taken from "Encycopedia of Chemical Technology," first supplement volume, p. 708, Interscience Encyclopedia, Inc., New York, N. Y.,) 1957.

shown. These changes occur as we vary the molecular weight while holding the resin density constant. Significant differences can be found in environmental stress-crack resistance, Izod impact strength, and molding characteristics. Tensile strength and creep are altered only slightly.

Two additional factors must be considered for the polyethylene copolymer, (0.95 density), however. These changes do not follow the standard pattern of a polyethylene homopolymer. In the case of the copolymer, the introduction of branching means reduced Izod impact strength and much lower creep in drawn fibers. Branching in the homopolymer, on the other hand, meant improved Izod impact and increased creep.

Table 1. Density and Chrystallinity Values for Various Polyethylene Resins.

Polyethylene	Density	Crystallinity, %
Fortiflex A	0.960	93
Fortiflex B59 Copolymer	0.950	87
Fortiflex B45 Copolymer	0.945	84
Ziegler High-Density	0.945	85
Regular branched	0.918	65

Table 2. Polyethylene Properties that Depend on Density.

Higher Branching means Lower Crystallinity (93-84%) means Lower Density (0.960-0.945) means:
Better Stress-Crack Resistance (poor to excellent),
Lower Stiffness, 140,000 to 80,000 psi.,
Slightly Lower Hardness, Shore "D" 65 to 63,
Slightly Lower Softening Point, 260° to 250° F.,
Slightly Lower Heat Distortion Point, 185° to 175° F. @ 66 psi.,
Slightly Lower Tensile Strength, 3,600 to 3,000 psi.,
Better Molding Characteristics.

Table 3. Polyethylene Properties that Depend on Melt Index.

Higher Molecular Weight means Lower Melt Index means:
Better Stress-Crack Resistance,
Higher Izod Impact Strengths,
Slightly Higher Tensile Strengths,
Higher Molding Temperature Requirements,
Better Hot Melt Strengths,
Slightly Lower Creep.

Table 4. Comparison of Properties for a Polyethylene Homopolymer and Copolymer.*

	Fortiflex A Homopolymer	Fortiflex B Copolymer
Density, gms./cc.	0.96	0.95
Melt index	0.2	0.2
Heat distortion temperature, ° F. at 66 psi.	185	175
Izod impact strength, ft.-lbs./inch of notch	23	7
Tensile strength at two inches/minute, psi.	3,700	3,200
Elongation at two inches/minute, %	28	30
Environmental stress-crack resistance, F50 value, hrs.	190	2,000
Softening temperature, ° F.	260	255
Stiffness in flexure, psi.	140,000	100,000
Hardness, Shore "D"	65	64

* Determined on 1/8-inch thick injection molded specimens. Tensile and elongation data recorded at first yield point.

Properties

To discuss the question of "Why A Copolymer?" we must review the exact physical properties of a polyethylene copolymer of 0.95 density compared with a polyethylene homopolymer of 0.96 density. Table 4 lists the values of each resin having a melt index of 0.2. The greatest property differences are in environmental stress-crack resistance and Izod impact strength. Other property changes in the copolymer are what might be expected with a drop in density from 0.96 to 0.95. Environmental stress-crack resistance improves from 190 hours to more than 2,000 hours, based on F50 values for the Bell Labs Test on the copolymer. Izod impact strength changes from 23 foot-pounds per inch of notch for an 0.2 melt index, 0.96 density homopolymer to seven foot-pounds per inch of notch for a 0.2 melt index, 0.95 density copolymer.

The difference in Izod value is not a true indication of toughness. To establish a practical relationship be-

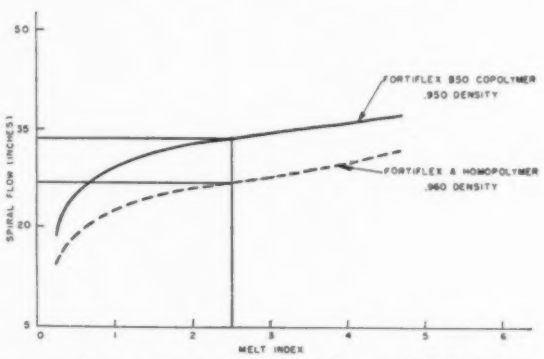


Fig. 3. Effect of melt index on spiral flow at 480° F. Pressure on material, 12,000 Psi.

Table 5. Impact Strengths of Polyethylene Homopolymer and Copolymer.

	Melt Index	Izod Impact at 73° F., Ft.-Lbs./Inch of Notch	Practical Impact F50**, Ft.-Lbs. to Break	
			At 73° F.	At 10° F.
Fortiflex A-70* ..	0.7	18	24	19
Fortiflex B50-80#	0.8	5	21	15
Fortiflex A-250 ..	2.5	13	19	14
Fortiflex B50-250 .	2.5	3	17	14
Fortiflex A-500 ..	5.0	3	10	10
Fortiflex B50-500 .	5.0	1	11	11

* Fortiflex A is a 0.96 density polyethylene homopolymer.
\# Fortiflex B is a 0.95 density polyethylene copolymer.
** Determined by falling ball on injection-molded boxes, nine x three x 1½ inches 0.070-inch thick. F50 is reading at 50% failure.

tween each of the various melt-index copolymers and the 0.96 density homopolymer with regard to impact strength, a laboratory test was run on molded parts. Injection-molded boxes, three inches wide by nine inches long by 1½ inches deep, with a 0.070-inch wall, were tested by a falling ball drop impact. Results were obtained on parts from 0.7 melt index to 5.0 melt index at test temperatures of 73° and 10° F.

Table 5 gives an outline of the materials tested, the Izod impact strength for each, and the corresponding values for F50 practical impact strength (in foot-pounds to break) at 73° F and 10° F. The F50 values listed refer to the reading at 50% failure of the specimens. Although the Izod values are considerably lower for a corresponding melt index in the copolymer, it will be noted that the practical impact strength is about equivalent to that of the homopolymer. The Izod impact values for the homopolymer show a drop from 18 foot-pounds per inch of notch for Fortiflex A-70 to three foot-pounds per inch of notch for Fortiflex A-500. The practical impact, however, undergoes only a 50-60% reduction from 24 to 10 foot-pounds.

Processability of the copolymer compared to the 0.96 density homopolymer is shown in Figures 3 and 4. The spiral-flow evaluation is an actual molding trial under fixed machine conditions of time, temperature, and pressure. This method utilizes a spiral or race-track type mold, to determine linear flow of the polymer. The length of the molded spiral is the measure of resin processability. Spiral flow studies (see Figure 3) rate the copolymer with a 40% improvement in flow for a

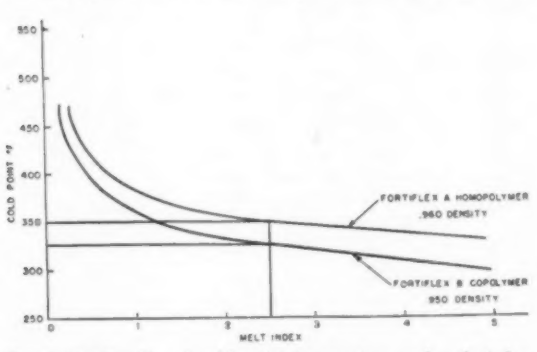


Fig. 4. Relationship of cold point temperature and melt index.

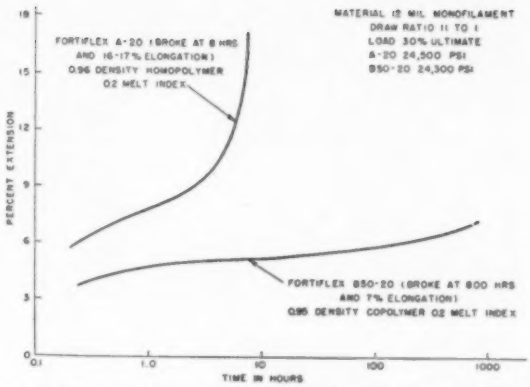

MATERIAL 12 MIL MONOFILAMENT
DRAW RATIO 11 TO 1
LOAD 30% ULTIMATE
A-20 24,500 PSI
B50-20 24,300 PSI
FORTIFLEX A-20 (BROKE AT 8 HRS AND 16-17% ELONGATION) 0.96 DENSITY HOMOPOLYMER 02 MELT INDEX
FORTIFLEX B50-20 (BROKE AT 800 HRS AND 7% ELONGATION) 0.95 DENSITY COPOLYMER 02 MELT INDEX
PERCENT EXTENSION
TIME IN HOURS

Fig. 5. Effect of time on percent extension of two polyethylene copolymer drawn fibers with differing melt index values.

melt index of 2.5.

Figure 4 shows results of a molding study on temperature requirements for the homopolymer and copolymer. The test consists of determining the minimum temperature of the material (defined as the cold point) necessary to fill a given injection die. Machine conditions of time and pressure are held constant, while material temperature alone is varied. These tests rate the copolymer with approximately a 20° F. reduction in temperature requirements for a 2.5 melt index.

Table 6. Effects of Melt Index on Polyethylene Properties.

	Fortiflex	
	B50-20	B50-80 to B50-500
Melt index	0.2	0.8-5.0
Properties dependent on melt index:		
Heat distortion temp. at 66 psi., °F	170-175	170-175
Izod impact strength, ft.-lbs./in.	7	5-1
Tensile strength at 0.2 inches/min., psi.	3,200	3,100
Elongation at 0.2 inches/min., %	30	25-18
F50 environmental stress-cracking, hrs.	2,000*	160**
F50 thermal stability at 70° F., hrs.#	>2,500	>2,500
Properties Practically Independent of Melt Index:		B-50
Density, gms/cc.		0.95
Softening temperature, °F..		255
Stiffness in flexure, psi.##		100,000
Hardness, Rockwell "R"....		40
Shore "D".....		64
Flammability, inches/minute		1.0
Water absorption, 24 hrs. @ 77° F.		<0.01

* By Bell Laboratories method.
** For Fortiflex B50-80.
\# Involves winding a coated-wire sample around itself 10 times, tying the end, and aging in air at 70° C. until failure.
Method of Karrer et al, Ind. Eng. Chem., Anal. Ed., 2, 96 (1930).

Reduction in creep of a fiber drawn from the polyethylene copolymer has led to its immediate use. Figure 5 compares a 0.2 melt index resin in both 0.95 and 0.96 densities. The improvement in the copolymer with respect to this property is outstanding. The homopolymer material broke in eight hours and 17% elongation, whereas the copolymer did not fail until 800 hours and showed only a 7% elongation. The tensile load in each case was about 24,400 psi.

Before we consider where to use this new resin, let us review the complete range of properties available in the 0.95 density. The physical properties from 0.2 to 5.0 melt index are shown in Table 6. The first part of this Table lists the physical properties that depend on melt index. Many of these values have been reviewed previously; however, particular attention should be paid to the tests of environmental stress-cracking resistance and thermal stability at 70° C. for coated wire. The copolymer resins of 0.95 density and 0.2 melt index have withstood 2,000 hours in environmental stress-cracking resistance, and in excess of 2,500 hours in pigtail wire thermal-stability tests. The second part of the Table outlines the physical properties of the 0.95 density copolymer which are practically independent of melt index.

Applications

The specific properties of the polyethylene copolymers immediately suggest the suitable fields of application. In each case, they fill a slight deficiency in the high-density homopolymer field.

The excellent rating in environmental stress-crack resistance and thermal stability offers possibilities for extruded wire and cable coverings, blow-molded bottles for the detergent field, and industrial moldings such as detergent dispensers and insert-molded parts. In this later field, it is possible to use a copolymer of higher melt index to gain processability and surface gloss with suitable environmental stress-crack resistance. As an example, the Celanese Application Laboratory has had insert-molded copolymer parts made of 2.5 melt index and 0.95 density resin under test with 10 pounds torque in Igepal at 180° F. for six weeks with no failure.

The low creep of this material in the oriented state has accounted for the excellent results obtained in extruded monofilaments. Such applications as rope are now using this resin quite extensively.

The improvement in processability in extrusion and molding suggests the fields of film extrusion and industrial molding. Film has been run in each of the three standard techniques; water bath, chill roll, and blown. In injection molding, the processability of the copolymer will tend to reduce material temperature requirements and, therefore, alleviate problems of excessive shrinkage associated with excessive temperatures.

Conclusions

Polyethylene copolymers, new members of the polyolefin family, offer many advantages to the plastic industry. The properties of improved environmental stress-crack resistance, reduced creep in drawn fibers, and improved processability suggest applications in wire and cable, blown bottles, monofilament, and industrial molding.

—THE END

Did Macy's tell Gimbels?

Macy and Grace executives observe the blow-molding demonstration conducted recently in Macy's basement. From left to right, they are A. Manchee, Macy president; Peter Grace, W. R. Grace president, J. Strauss, Macy chairman; and E. E. Winne, vice president of Grace's polymer chemicals division.

Sales of plastic housewares were given a shot in the arm recently, with the installation of a blow-molding machine in Macy's basement. The well-known New York department store scored another first—actual production of a polyethylene refrigerator container for "on-the-spot" sale. W. R. Grace & Co. supplied the material and Kautex the machine.

Response was so great that the machine had to be run nights after closing time to keep up with demands. The containers were blown at the rate of 120 per hour.

Stabilization of vinyl copolymer resins
(Cont'd. from page 38)

Key for Figures

PVC	polyvinyl chloride polymer
PVC-AC	vinyl chloride-vinyl acetate copolymer
PVC-VDC	vinyl chloride-vinylidene chloride copolymer
DOP	di-2 ethylhexyl phthalate
CD	cadmium soap—15% cadmium
BA	barium soap—21% barium
ZN	zinc soap—8% zinc
ORG	mixed alkyl-aryl phosphite
ESO	epoxidized soybean oil
ER	epichlorhydrine-bisphenol condensation epoxy resin
DBTM	dibutyl tin maleate
TS	tin mercaptide stabilizer
DPST	di basic lead stearate
DPP	di basic lead phosphite

—THE END

Heat–resistant encapsulating resins

Heat resistance of an encapsulating resin system should be evaluated on the results of a combination of thermal tests.

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R. D. Hodges

HEAT resistance has different meanings to different people who think of it in terms of its ultimate end-use. The term "heat-resistance" automatically brings to mind high temperatures. This, in the case of organic polymeric materials, may vary from as low as 125° C. for such applications as electric motors with a useful operating life of approximately 20 years, to as high as 500° or even 1,000° C. in guided missile and rocket applications where the useful life often is measured in minutes or even seconds. Perhaps it is better not to classify a resin as heat-resistant, but to present sufficient data about it and let the end user decide for himself whether or not it is heat resistant.

The term "encapsulating resin" also needs clarification. In the narrow sense, it is a resin used to encase a component or product. Used here in a much broader sense, it is a generic term for a number of applications including casting, potting, embedding, impregnating, and even laminating. In general, resins suitable for such applications are solventless, 100% polymerizable liquids which are capable of being converted to insoluble, infusible solids.

Only one solventless, polymerizable casting resin group—the liquid phenolics—was available commercially 20 years ago. It had many properties that were unsuitable for encapsulating applications and, hence, found little use in electrical equipment. A number of new families of polymerizable resins have since become available, namely: the unsaturated polyester copolymers, silicones, epoxies, isocyanates, polybutadienes, and resins based on styrene and other monomers. To add to the user's confusion, both physical and chemical blends (alloys) of these resins have been developed so that literally dozens of these basic resin compositions can qualify for encapsulating applications.

An encapsulating resin system consists of a resin and catalyst or curing agent. Modifiers such as fillers, fibers, pigments, or flexibilizers usually are added to meet special requirements not attainable in the resin-curing agent system alone.

Encapsulating resins are being subjected to an ever widening range of temperatures. The success or failure of costly electrical equipment very often depends on a few dollars or even a few cents worth of resin. Therefore, the real questions are—"Will it take the temperature, and what are its mechanical or electrical properties at that temperature?" These and many questions of a similar nature must be answered with a reasonable degree of accuracy if the design engineer is to consider using the resin or make best use of the encapsulated resin system.

This report compares the relative heat resistances of a number of epoxy resin-hardener systems based on their heat distortion temperatures, weight losses on heat aging, and changes in electrical properties with temperature and/or heat-aging. The most heat-resistant epoxy resin-hardener system then is compared with other types of supposedly heat-resistant resins on the same basis. All data presented pertain only to unfilled resin systems although, for many applications, fillers are essential. Factors such as adhesion of resin to filler, heat transfer due to presence of fillers, and shrinkage during cure are so important that presenting information on unfilled systems may have little practical meaning for many applications. However, such information must be available if we are to know what effects the presence of fillers and other modifiers have in encapsulating resin systems.

Complete basic information on room-temperature mechanical, electrical, and physical properties of most commercial polymerizable resins usually is not available, even from their manufacturers. The difficulties encountered in obtaining data at elevated temperatures are so much greater that available information is proportionately less. Where encapsulated resin systems are subjected to elevated temperatures for prolonged periods of time, information on their thermal properties is absolutely essential. It is usually up to the user or the resin formulator to obtain this information unless he

In its early form, this paper was presented at the 15th ANTEC, Society of Plastics Engineers, Inc.
* Now Consultant—Plastics & Electrical Insulation, Fort Wayne, Ind.

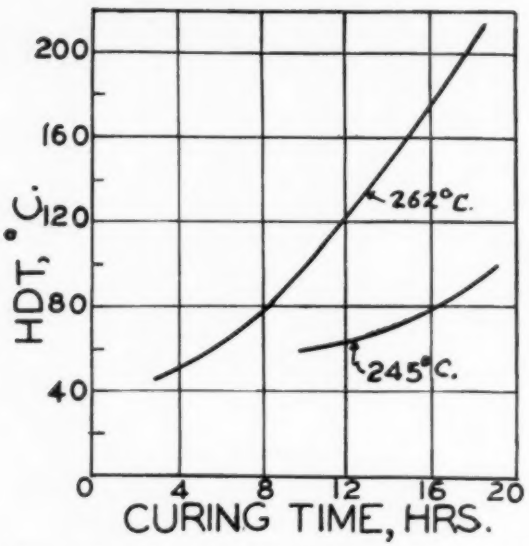

Fig. 1. Effect of curing conditions on the heat-distortion temperature of Butarez 15 polybutadiene resin.

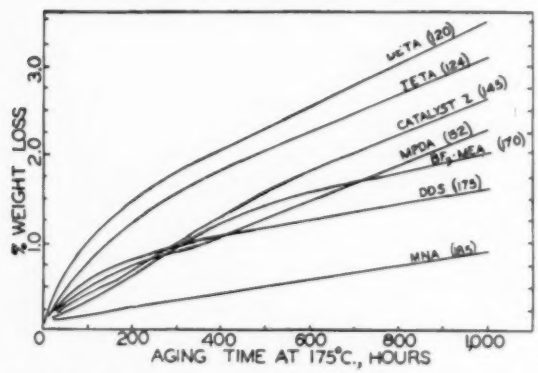

Fig. 2. Effect of hardener on weight-loss of Epon 828 epoxy resin on aging at 175° C.

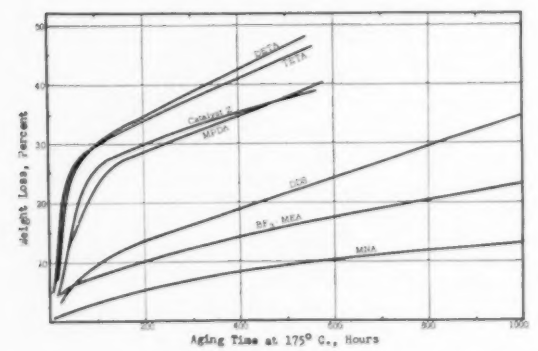

Fig. 3. Effect of hardener on weight-loss of Epon 828 epoxy resin on aging at 250° C.

can convince the resin manufacturers that it is to their economic gain that the information be made available.

Heat-Distortion Temperature

A wealth of information can be obtained with comparatively little effort from the heat-distortion temperature (H.D.T.) of the cured resin. This temperature, as determined by standard ASTM procedures, indicates the softening temperature of the resin, or at least the approximate temperature range at which the resin starts to soften. Although it cannot always be correlated with other properties, it is very important to know, especially if the cured resin is under physical loading at elevated temperatures.

The mechanical properties of a resin (such as tensile, compressive, and flexural strengths) start to show signs of serious deterioration as the temperature approaches the H.D.T. For many cured resins, especially the polar or "lossy" type, the electrical properties also start to deteriorate in the region of the H.D.T., which is also a measure of the degree of cure of a resin system, providing the maximum H.D.T. of that particular resin system is known. It also is a rough measure of the resin's thermal stability; that is, the resins which have the least weight loss on heat aging have comparatively high H.D.T. values. A detailed discussion of this is given in a later section.

For a given resin-catalyst system, the H.D.T. is a function of the type and concentration of catalyst and the conditions under which it is cured. The effect of curing conditions on the H.D.T. of a polybutadiene resin, Butarez 15, is shown in Figure 1. This resin is a liquid, unsaturated hydrocarbon polymer of butadiene, and is made by Phillips Petroleum Co., Bartlesville, Okla. No catalyst or curing agent is needed, since curing can take place by thermal polymerization of the double bonds to give a highly cross-linked, rigid polymer. The heat-distortion temperature increases with continued curing, and at a faster rate when cured at higher temperatures. If we cure at excessively high temperatures, the rate of degradation will exceed the rate of cross-linking so that the heat-distortion temperature will show a drop rather than an increase.

The heat-distortion temperatures of a number of epoxy-hardener systems are shown in Table 1.* The epoxy resin used in all tests is Epon 828, a liquid diepoxide marketed by Shell Chemical Corp., New York, N. Y. In general, other commercial liquid diepoxides of equivalent epoxy content, such as Ciba's Araldite 6020, Jones-Dabney's 510, or Bakelite's ERL-2744, have almost equivalent H.D.T. ranges, as reported by the literature. The anhydrides impart the highest H.D.T. values, whereas the aliphatic amine-cured epoxies have the lowest H.D.T. values. Methyl nadic anhydride**, a liquid hardener, is of particular interest not only because it imparts a high heat distortion temperature, but also has a long pot life at room temperature, is easy to handle and, as is pointed out later, imparts excellent thermal stability as well. It is preferable to add one part

* Many of the heat-distortion values were taken from Shell Chemical Co. bulletins.
** Made by National Aniline Div., Allied Chemical Corp., New York, N. Y.

Table 1. Heat-Distortion Ratings for Epon 828 Epoxy-Hardener Systems.

Hardener System & Amount	H.D.T., ° C.
Amines:	
Aliphatic	
Ethylene diamine	90
Diethylene triamine (10)	120
Triethylene tetramine (10)	125
Piperidine (6)	100
Diamino menthane (22)	157
m-Xylylene diamine	115
DMAPA (10)	97
DEAPA	82
TEA (12)	75
Dibenzyldimethylamine (10)	97
DMP-30 (6)	112
Catalyst D (10.5)	92
Aromatic	
m-Phenylene diamine (Cat. CL) (14)	153
p-Phenylene diamine (15)	145
p,p'-Methylene dianiline (25)	157
MPDA + MDA (Cat. Z) (20)	145
Benzidine (24)	165
p,p'-Diaminodiphenyl sulfone (BF_3•400) (30)	175
BF_3•Ethylamine (3)	170
Anhydrides:	
DDSA (130)	78
Phthalic anhydride (BDMA 0.1) (7.5)	150
Hexahydrophthalic anhydride (BDMA 1) (80)	132
Methyl Nadic Anhydride (BDMA-1) (91.8)	185
Het Anhydride (Chlorendic) (110)	190
Pyromellitic Dianhydride (46)	260

Table 2. Heat-Distortion Temperatures of Various Types of Encapsulating Resin Systems.

Resin Type	Resin System	H.D.T., ° C.
Silicone	Dow-Corning R-7501 (filled). 2% Dicup	150
Epoxy	Epon 828 + Methylene Dianiline (25)	158
	Araldite 6005 + Methyl Nadic Anhydride (DMP-30)	168
	Epon 828 + Pyromellitic Dianhydride	260
Polyester	Vibrin 135 + 1% Benzoyl Peroxide	200
	Laminac 4332 + 0.5% Benzoyl Peroxide	270
	Permafil 73517 + 1.0% Butyl Perbenzoate	165
Polybutadiene	Butarez 15	205

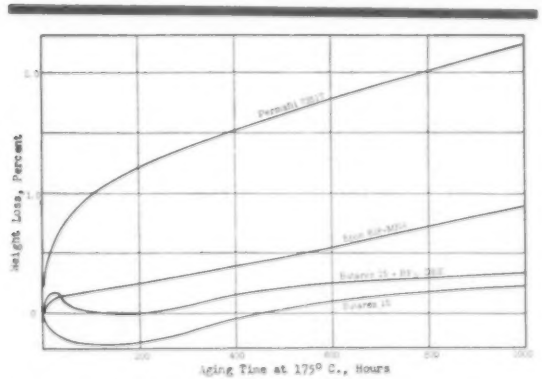

Fig. 4. Effect of aging at 175° C. on the weight-loss values for four encapsulating resin systems.

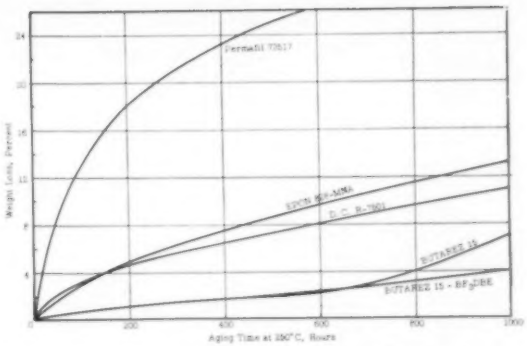

Fig. 5. Effect of aging at 250° C. on the weight-loss values for five encapsulating resin systems.

of a tertiary amine, such as benzyldimethylamine, to 100 parts of resin to accelerate the cure.

Table 2 compares the heat-distortion temperatures of different families of solventless, polymerizable resins. These resin systems may be considered as representative of the most thermally-stable resin in each family, although the choice of commercial silicone and polybutadiene resins is rather limited. All of these resins have H.D.T. values above 150° C., which indicate that they retain a reasonable portion of their room-temperature mechanical properties at least to 150° C. Other pertinent information as supplied by their manufacturers, is given in Table 3.

Weight Loss

Another measure of an encapsulating resin's thermal stability is weight-loss rate by aging at elevated temperatures. The information gained by aging cast plastic specimens at elevated temperatures for prolonged periods of time can often be misleading, if judgment is based only on this method. It takes a combination of thermal tests to make a true analysis of the heat resistance of a resin system.

Weight-loss determinations were made on 1- x 2- x ⅛-inch cast plastic specimens by aging at 175°, 200°, 225° and 250° C. for 1,000 hours. The samples were placed in tared aluminum foil dishes so that practically all of the surface area was exposed to the hot air in a forced-draft oven. The effect of curing agent type on the weight loss of an epoxy resin, Epon 828, on aging at two temperatures (175° and 250° C.) is shown in Figures 2 and 3, respectively. All of the samples were cured according to the directions furnished by the resin manufacturer, and then conditioned at 175° C. for 16 hours to attain maximum heat-distortion temperature.

The epoxy resin cured with the aliphatic amine hardeners had the highest weight-loss rate, whereas the methyl nadic anhydride-cured resin had the lowest rate. The heat-distortion temperature of each hardener system is given in parentheses in Figure 4. It is interesting to note the very close relationship between the heat-distortion temperature and the weight-loss rate. Although this relationship is not always consistent, a good rule to follow is that the more heat-resistant resins also have comparatively high heat-distortion temperatures.

Table 3. Properties of Heat-Resistant Encapsulating Resins.

	Laminac 4232 (Amer. Cyan.)	Vibrin 135 (Naugatuck)	Permafil 73517 (Gen. Electric)	Epon 828 (Shell)	R-7501 (D-C)	Butarez 15 (Phillips)
Resin type	Polyester	Polyester Triallylcyanurate	Polyester styrene	Epoxy	Silicone	Polybutadiene
Catalyst	Benzoyl peroxide	Benzoyl peroxide	t-Butyl perbenzoate	Methyl nadic anhydride	Dicumyl peroxide	(None)
Per cent	0.5	1.0-2.0	1.0	90 pph.	2.0	—
Storage stability, mos.:						
Uncatalyzed	6	12	>12	>12	>12	>12
Catalyzed	—	72 hrs.*	1	Sev. hrs.	>6	—
Curing Temp., ° C.	—	75-175	100-150	120-200	127-200	220-260
Time, Hrs.	—	3	2	5	10	10
Shrinkage, %	—	Approx. 10	7-8	2-3	—	8
Strength (R.T.), Psi.:						
Tensile	—	6,000	—	11,000-12,000	2,800	4,000-5,000
Flexural	7,200	15,000	—	20,000	5,900	8,000-8,450
Impact (Izod), Ft. lbs./in.	—	0.20	—	—	0.20	0.247
Water absorption, % in. 24 hours	—	0.73	—	—	0.04	—

* At 70° C.

Table 4. Continuous Operating Temperatures for Resin-Catalyst Systems at Various Weight-Loss Rates.

	Weight Loss per 1,000 Hours							
	16%		4%		1%		0.1%	
Useful life, years*	0.114		0.457		1.83		18.3	
	Temperature, ° C.		Temperature, ° C.		Temperature, ° C.		Temperature, ° C.	
Resin Systems	Operating	Relative	Operating	Relative	Operating	Relative	Operating	Relative
Epon 828 and TETA	217	—38	190	34	165	—31	127	—30
MPDA	227	—28	200	—24	176	—20	141	—16
DDS**	234	—21	208	—16	186	—10	151	— 6
BF_3•MEA	242	—13	212	—12	185	—11	145	—12
MNA	255	0	224	0	196	0	157	0
Permafil 73517	234	—21	204	—20	178	—18	141	—16
Silicone R-7501	283	+28	190	—34	—	—	—	—
Butarez 15 and no catalyst	262	+ 7	240	+16	213	+17	—	—
BF_3•DBE#	290	+35	250	+26	215	+19	166	+ 9

* Based on 16% maximum permissible weight-loss for useful life.
** Diaminodiphenyl sulfone.
# Borontrifluoride-dibutylether.

Similar weight loss determinations were made on other types of encapsulating resins. Dow-Corning's silicone resin, R-7501; General Electric's polyester resin, Permafil 73517, and Phillips Petroleum's polybutadiene resin, Butarez 15, were selected for comparison with the epoxy resins because of their good physical and electrical properties at elevated temperatures. These resins are comparatively new, and more technical information on their thermal stability would be of interest.

The results of weight-loss determinations on these resin systems are shown in Figures 4 and 5. The polyester resin, Permafil 73517, has a surprisingly low weight-loss rate for a styrene-polyester copolymer, and compares favorably with commercial diallylphthalate- and triallylcyanurate-polyester copolymers in this respect.

The polybutadiene resins had the lowest weight-loss rates of all the resins tested. The boron trifluoride-dibutylether catalyst in the polybutadiene resin did not seem to impair its thermal stability. In fact, at 250° C. heat aging, the boron trifluoride-cured polybutadiene is superior to the uncatalyzed polybutadiene.

The polybutadiene resins showed a weight gain instead of a loss during the first few hundred hours aging at 175° and 200° C. This behavior is explained by the addition of oxygen to the residual double bonds in the cured resin to give a comparatively stable addition product which breaks down gradually on continued aging. At 225° C., and higher, the rate of degradation exceeded the rate of oxygen addition so that a net weight-loss was observed at all times.

In Figures 6 and 7, an attempt is made to put some values on the maximum continuous operating temperature and the relative thermal stability of these resin systems. By plotting the log time against 1/T (where T is in °K), a reasonable straight-line relationship is

obtained which can be extrapolated to lower or higher weight-loss per 1,000 hours aging. This is shown in Table 4#. Using methyl nadic anhydride-cured epoxy as a basis for comparison, the continuous operating temperature difference also is given. For example, the triethylene tetramine-cured epoxy resin would lose 16% of its weight on heating at 217° C. for 1.000 hours, whereas the methyl nadic anhydride-cured resin would have to be heated at 255° C. to obtain the same weight-loss rate, a temperature advantage of 38° C. for the anhydride-cured resin.

If we assume a maximum allowable weight-loss of 16% for the useful life of an encapsulating resin, then the useful life of an epoxy-TETA resin system on aging at 217° C. would be 1,000 hours. For many applications, such as motors and transformers, the useful life is measured in many years. At a 0.1% weight-loss rate per 1,000 hours aging, the useful life is 18.3 years, based on a 16% allowable weight-loss. Therefore, the aging temperature (127° C.) at 0.1% weight-loss per 1,000 hours aging is also the maximum continuous operating temperature.

Tests indicate the thermal stability of the polybutadiene resin to be outstanding. The silicone resin proved excellent at very high aging temperatures, but fell off rapidly on aging at lower temperatures. One explanation for this behavior is based on its rather slow curing rate. It appears that the resin system is not completely cured during the early stages of the heat-aging tests, thus being vulnerable to elevated temperatures. As it continues to cure on heat-aging, it becomes more cross-linked; hence, more thermally stable. Epoxy resins cured with methyl nadic anhydride also compare very favorably with other heat-resistant resin systems.

It is significant that polybutadiene resins exhibited outstanding thermal stability for completely organic polymers. Whereas other resins degrade at elevated temperatures due to a combination of oxidation and limitations of bond energies (ester, amide, ether, and similar bonds), the polybutadiene resins degrade primarily by oxidation. Close inspection of the surface of a heat-aged sample shows a very thin, compact, carbon film formation over the entire surface which greatly protects the interior from further oxidation. Thus, the effect of surface area exposed to the hot air becomes increasingly important. Extremely thin films were found to degrade at a much higher rate than thick sections.

The presence of fillers can also have a deleterious effect on encapsulating resins which tend to degrade oxidatively. Figure 8 shows the weight-loss of Butarez 15 and Silicone R-7501 resins, each containing approximately 150 parts silica flour per 100 parts of resin. Although the unfilled Butarez resins had much lower weight-loss rates than the unfilled silicone resin, the reverse was true with the filled resins at temperatures above 225° C.

Abbreviations of epoxy resin hardeners are as follows: DMAPA—dimethylaminopropylamine; DEAPA—diethylaminopropylamine; TEA—triethanolamine; DMP-30—tris, dimethylaminomethyl phenol (Rohm & Haas Co., Philadelphia, Pa.); MPDA—metaphenylenediamine; MDA—methylenedianiline; BF_3•MEA—borontrifluoride monoethylamine; DDSA—dodecylsuccinic anhydride; BDMA—benzyldimethylamine; DETA—diethylenetriamine; TETA—triethylenetetramine; MNA—methyl nadic anhydride. Catalysts D, CL, Z, and BF_3•400 are hardeners marketed by Shell Chemical Co., New York, N. Y.

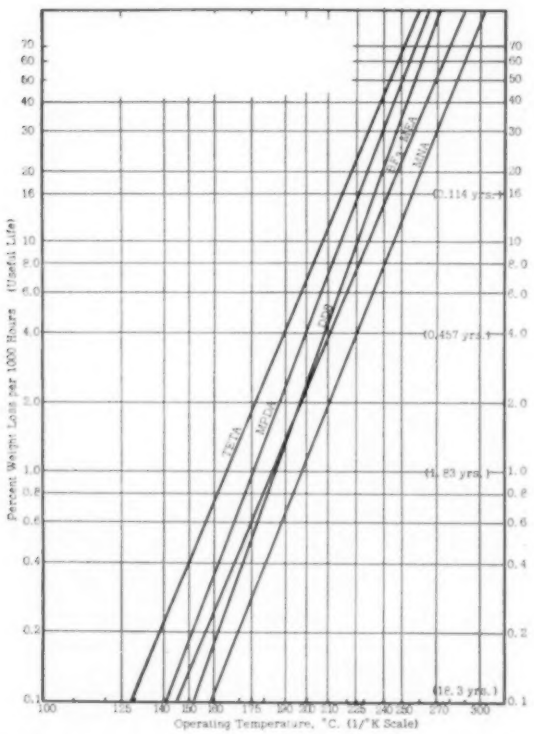

Fig. 6. Effect of hardener on continuous operating temperature of an Epon 828 epoxy-hardener system.

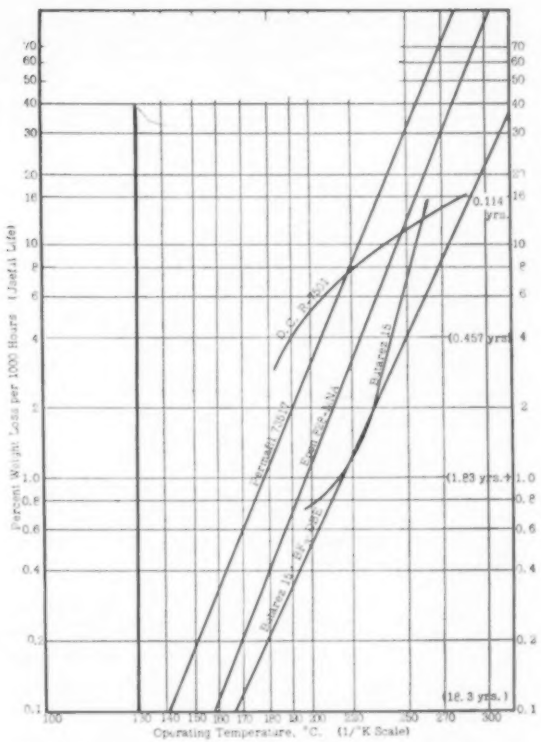

Fig. 7. Continuous operating temperatures of five heat-resistant encapsulating resins at various weight-loss rates.

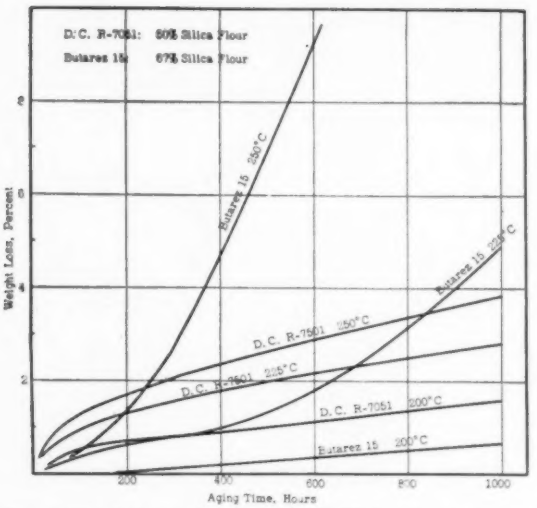

Fig. 8. Weight-loss rates for five silica-filled resin systems on aging at various temperatures.

One explanation for this behavior is that the exposed area at the surface is increased considerably due to the difference in coefficient of expansion between the resin and the silica filler. This permits the hot oxygen molecules to bore into the casting at a much higher rate. The silicone resin either has better adhesion to the silica filler (thus preventing an increase in surface area), or is much less subject to degradation by oxygen. It generally is conceded that the latter is true. At temperatures below 200° C., the surface area is not increased materially, therefore, the filled polybutadiene resin degrades at a normal rate.

Electrical Properties

Information on the effects of heat-aging and elevated temperatures on the electrical properties of an encapsulating resin are just as important as information on its mechanical and chemical properties. Low electrical losses are essential in high-frequency applications. High electrical losses will cause excessive heating, as well as decreased efficiency of equipment. Many resins, especially the polar types (such as those containing hydroxyl, carboxyl, amino, halogens, or similar groups), may have a low dissipation factor at room temperature, but become quite "lossy" as the temperature is increased. This is attributed partially to polarization of polar groups in an electric field at elevated temperatures where they have more freedom of movement. At room temperature, the polar groups are frozen-in. For this reason, high heat-distortion resins usually show less change in electrical properties with temperature up to their heat-distortion temperature than do the low heat-distortion temperature resins within the same family.

The effect of temperature on dielectric constant and dissipation factor of several heat resistant resins is shown in Figure 9. All measurements were taken at 10^5 cps., except for the silicone resin, R-7501, which was taken at 10^6 cps. The dissipation factor for this resin at 10^5 cps. is probably somewhat higher. H.D.T. values are shown in parentheses. The silicone resin, R-7501, and the polybutadiene resin, Butarez 15, had low electrical losses at room temperature which do not significantly increase with increasing temperatures—at least to 200° C.

Table 5. Effect of Aging at 200° C. on Volume Resistivity* of Heat-Resistant Encapsulating Resins.

	Aging Time, Hours		
	0	200 @ 200° C.	400 @ 200° C.
Polyester:			
Permafil 73517	6.38×10^{15}	2.8×10^{15}	8.3×10^{15}
Epoxy:			
Epon 828-MNA	4.65×10^{13}	2.4×10^{14}	2.8×10^{14}
Polybutadiene:			
Butarez 15 with no catalyst	$>2.43 \times 10^{16}$	$>2.43 \times 10^{16}$	$>2.43 \times 10^{16}$
Butarez 15 with 1.5% BF_3•DBE	1.76×10^{14}	8.03×10^{15}	$>2.43 \times 10^{16}$

* At 125° C., 202.5 volts (test voltage), one minute electrification time.

The polyester resins, although more "lossy," also did not change significantly within the same temperature range. However, the electrical losses of the epoxy resin increase rapidly at temperatures above 150° C. There also appeared to be a relationship between H.D.T. values and the dissipation factor (or electrical losses) similar to the relationship of H.D.T. values to mechanical and weight-loss properties. However, the relationship pertains only to the polar-type resins since the non-polar polybutadiene and presumably silicone resins theoretically should not show significant increase in dissipation factor with temperature regardless of the H.D.T. value.

The degree of change in dissipation factor depends on the type and quantity of polar groups. Apparently the polyester resins have fewer or less "lossy" polar groups than do the epoxy resins. The polar groups in Laminac 4232 are still frozen-in at 200° C. Its electrical losses would probably increase rapidly in the region of

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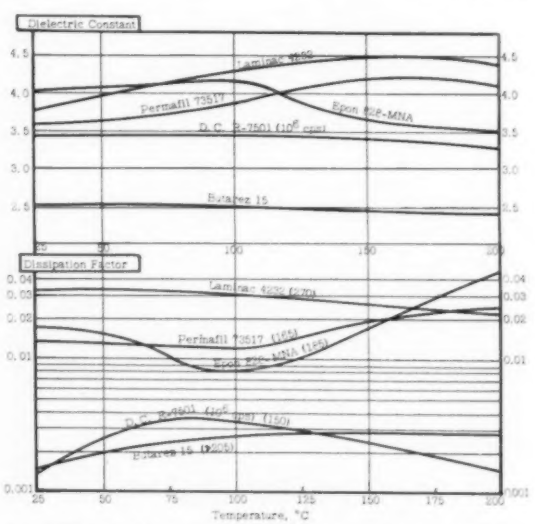

Fig. 9. Effect of temperature on dielectric constant and dissipation factor of five heat-resistant encapsulating resins.

Guest editorial

Industrial publicity— just the facts

S. J. SAUNDERS
Industrial Press Relations
San Carlos, Calif.

IT'S JUST about time someone took the wraps off industrial publicity so that the interested, curious, and befuddled can take a soul-searching look at it. There's been so much nonsense, noise, and confusion on this subject that many a manufacturer is delaying valuable public relations effort simply because he does not know the facts. In this rather limited space, we'll try to give the score—hits, runs, and errors.

Just what is industrial publicity? It is a sound method employed by industrial companies to obtain favorable mention of industrial products and/or services in leading magazines and newspapers. It is unlike all other forms of publicity, including technical publicity with which it is linked unjustifiably. Maybe we'd better unravel the differences between these two forms of publicity so there will be no further doubts.

Industrial publicity consists of feature articles, news releases, picture/caption stories, and other valid forms of news dissemination—all of the material aimed to the largest possible audience in industrial sales markets. Properly handled, industrial publicity will interest both the machine helper and the engineer; technical data will be screened to eliminate jargon; headline, opening paragraphs, and general writing style will be designed to stimulate the reader into reading; information so presented is bound to lead to some kind of action provided the subject matter is directly related to the reader's field.

Technical publicity, on the other hand, is meant strictly for the high-brow, the deep thinker, the so-called egghead. It is written for a limited and exclusive market. It consists not so much of down-to-earth, easily understood language, but rather of involved, outer space technical pontificating heavily larded with equations, logarithms, theorems, tables, graphs, and charts. It is designed primarily by one Ph.D. to impress his brothers and peers. To the average guy in the average factory, technical publicity is impressive but wholly brain-quashing. To us, the three most interest-deadening words in the language are: "Some Aspects of . . . "

The differences now should be clear. Industrial publicity reaches many, technical publicity very few. And because industrial publicity is more effective, it is used by alert manufacturers to obtain widespread coverage of their products, product applications, and services. By no means a substitute for advertising, sales promotion, or merchandising, it is nevertheless just as important or more so than the other three. And because it is important and because mishandling can result in high publicity costs for mediocre or damaging results, you should know some of the facts.

Fact 1—Industrial publicity is not free and anyone who tells you he can get you "free publicity" is after your scalp. A competent industrial publicist charges for the time he spends on your account and for the skill which enables him to give you a professional job. This handling cost is basic, and how much you pay will be determined by how much action you want. He will work on a monthly retainer or per-job basis, but either way decide the financial arrangements in advance.

The client also is expected to pay for necessary expenses incurred by the publicist in covering assignments. Typical expenses will include transportation, hotel, meals, and, quite often, customer entertainment. The latter can be most important, for the publicist is in effect an unofficial salesman for his client. His actions in the field will reflect back to the company he represents.

Then there are production costs; such items as photography, copy prints, enlargements, retouching, mimeographing of releases, postage, and the like. Such costs are essential to publicity handling, and have been cited specifically for those who thought that getting articles and releases into print was free.

Fact 2—The client gets full measure from a reliable industrial publicist. To do his job adequately, the publicist must evaluate story leads; get out in the field to interview engineers, chemists, physicists, company presidents, job foremen, and workers; write articles an editor will be proud to publish; consult with client management on forthcoming news breaks; write news re-

leases on all aspects of a product and its application; sit in on sales meetings to absorb data from sales engineers; dig up additional copy or photographs an editor may want; supply material for editorial round-ups; arrange for editors to interview company personnel; and set up special news conferences. These are the areas for which the publicist is responsible. The volume of actual work involved in the handling of an account most often exceeds the compensation.

Fact 3—Industrial publicity is not a weak sister to be sloughed off on your advertising agency as "something that has to be done so for Pete's sake, find some one to do it." You'll be deluding only yourself if you fail to regard publicity as an important segment of your selling program. Most ad agencies are ill-equipped to give you satisfactory industrial publicity action. They will shudder when the subject is raised because the service required is too highly specialized. Quite often, the end-result will be publicity you might have prepared better yourself.

Why is this so? Industrial publicists are not born; they are created out of sweat, stubbornness, and the ability to take notes in a steel mill, coal mine or foundry while oblivious to the noise, the dirt, and possible danger. In a conference room, they discuss problems with a vice president, yet are equally at home swapping notes with a lathe hand.

Above all, the publicist is interested in the functions of industry. As he broadens his coverage, he amasses an amazing knowledge of industrial applications. This background takes many years to accumulate and can not be learned out of books. The result is that the industrial publicist knows what industrial news is really news; what sort of information he needs and how to get it through interview or research; how releases and articles should be slanted and where to place them; how to avoid editorial antagonism by not giving in to management pressure for reams of extravagant slush.

Now if you were the head of an advertising agency, wouldn't you shudder?

Fact 4—Industrial publicity is not a one-shot process. It is quite difficult to understand the thinking of manufacturers who have two articles published and figure the publicity will carry them for years. It would be just as reasonable for them to expect two sales letters to duplicate the efforts of an entire sales force. Possibly we should recap some fundamentals: (a). Since magazine and newspaper readers have short memories, they must be jostled and cajoled constantly; (b). One or two articles and releases cannot establish a product or service image; (c). The company is not taking full advantage of all available industrial media; (d). Each new mention of a product is another notch in sales gun. (Anytime you think you've had enough publicity, just put away that gun—you'll have run out of ammunition.)

We'll put it still another way. Don't become interested in industrial publicity unless you're prepared to carry it through on a long-term basis. Nothing is more frustrating to a conscientious publicist than to have a program pulled up short or stopped just when it is beginning to show profitable results to his client. Do you know what they say? "We don't need any more publicity —we've got more business than we can handle." And do you know what we think as we fold up our tents? "Wait six months. Then wonder why the competition is taking your customers."

No, industrial publicity is not the absolute guarantee for a spiralling sales curve—but it does broadcast your message, increase interest, open up new sales markets, and create an over-all favorable impression of your company and its products and services.

Fact 5—Industrial publicity is a must for the small manufacturer. Look around and you won't find a single manufacturer of size and sales volume who doesn't have some kind of industrial publicity program. Most of them have been doing it for decades, some more extensively than others, but the point is that they do schedule it year in and year out. Why? Because it is vital.

Let's suppose a manufacturer of industrial products used every selling tool at his command but ignored publicity completely. The actual number of possible customers who would never hear of him or his products would stagger your imagination. No manufacturer has the necessary mint at his disposal to advertise, merchandise and sell in every conceivable area where his products can be used. Unless he does employ publicity to fill these gaps, he'll have to forget about them. That is why you'll find that major manufacturers either maintain their own publicity departments or engage industrial publicists to handle their accounts.

Since the above is the awful truth, the manufacturer of limited means is in a much tougher spot. His limited means include limited advertising, limited sales force, and limited merchandising. He wants to grow but he has just so much to spend to make it possible. If he's knowledgeable, he's aware of the need for publicity effort and is trying his best to do it himself on a hit-or-miss basis. Or he's heard about industrial publicity but doesn't know how it works nor how economical it can be if a program is tailored to his budget. Gentlemen, that precisely was the reason for this Guest Editorial.

—The End

Heat-resistant encapsulating resins

(Cont'd. from page 48)

its H.D.T. If these measurements were taken at 60 or 100 cps., the increase in electrical losses would be considerably higher.

Tests showed that volume resistivity decreases with increasing temperature. All of these resins have excellent room-temperature volume resistivity, although the epoxy resins appear to fall off rapidly at temperatures above 175° C.

The effect of aging at 200° C. on the volume resistivity of several heat resistant encapsulating resins is presented in Table 5. The measurements were taken at 125° C., so that they would be sufficiently below the upper limit of the testing equipment. In general, moderate heating (200° C. for 400 hours) improved the volume resistivity. These results are in agreement with those obtained by Goodyear and Hornburg.##

"Evaluation Tests for Epoxy Casting Resins," M. V. Goodyear and J. P. Hornburg, Elec. Mfg., 60, 3, 125 (Sept. 1957).

(Continued on page 53)

Developments in vinyl and related materials during 1959

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THE RESURGENCE of vinyl in 1959 after the leveling off of 1957-1958 was a remarkable performance for a relatively mature plastic. This new growth was distributed over various use categories, thus affording a good example of how sound technology produces expanding markets long after the growth due to radically new applications has become a minor factor. Although molding, extrusion, and flooring accounted for a good percentage of the resurgence, it generally can be ascribed to a steady build-up of knowledge in such areas as plasticization, stabilization, flow behavior, and foaming which made possible many small advances in the use of this versatile plastic. Further developments of this type, together with an expected expansion of metal lamination and the continued development of high- and intermediate-impact materials, offer excellent prospects. The steel and copper strikes probably prevented an even more, impressive market growth in 1959 through their depressing effect on wire coating, and the shortage of DOP plasticizer leading back through phthalic anhydride to naphthalene and coal tar from coking.

The use of chlorinated polyethylene in a vinyl compound to give formulations ranging from hard- to high-impact types to soft- to flexible varieties was an important development in 1959. The good weatherability of these formulations and the retention of dielectric properties in flexible materials are significant, as well as the fact that chlorinated polyethylene does not increase heat-stability problems and needs little additional plasticization. The chlorinated polyethylene in these blends acts more like the rubber in polyblends, than as a polymeric plasticizer (1)*.

An epoxidized soybean oil plasticizer has been described, which gives up to 10% greater epoxy content in the finished article and results in 25-40% greater heat stability. Good heat and ultra-violet light resistance were found for new plasticizers derived from turpentine (lauryl and tridecyl pinonate) (2).

Among the new secondary plasticizers available are Conoco H-35, a water-white material, having greater compatibility than other secondaries; and Somil, a polyalkylated benzene reported in the British literature (3) as having good heat and light stability.

A study of PVC's thermal decomposition at the National Bureau of Standards (4) involving a mass-spectrometric measurement of pyrolysis products, and a study of the energetics, indicated that a free-radical mechanism was involved. This concept disallows autocatalysis by evolved hydrogen chloride, a theory that was also discredited by Fuchsman (5). He emphasizes the role of oxygen, and proposes that hydrogen chloride is eliminated between non-neighboring chain atoms. The same author also points out pitfalls in evaluating stabilizers (6). He notes the different responses by various resins to the same metal-organic stabilizer, the possible synergism of zinc stabilizers with fillers, and the inadvisability of testing in sequence where the oven-temperature variations may obscure comparisons. The need for testing in relation to a realistic standard is pointed out. Unneeded long-term stability is a costly result of unrealistic evaluation of stabilizers.

The spotty pink discoloration of vinyl-coated fabrics in outdoor use was traced to a species of fungus (7). Fungicides eliminated this problem. Perry gives the results of a detailed study of the light-stability response to a wide variety of compounding ingredients (8). A barium-cadmium-phosphite-epoxy stabilizer combination gives excellent results with a further significant improvement being obtained with an ultra-violet absorber. Perry also reviews stabilizer development, with emphasis on the recent developments in the barium-cadmium type (9). The quantitative measurement of discoloration in plasticized films was simplified by relating areas under a spectral reflectance curve to the simpler measurements with a tristimulus colorimeter (10).

The possibility of mixing different types of resin to obtain plastisols of any desired degree of non-Newtonian index resulted from studies using a plate and cone viscometer (11). Werner gives basic rules for formulating organosols after considering the roles of resin, diluent, surface-active agent, and fusion conditions (12). Equipment, molds, pastes, resins, plasticizers, fillers,

* Numbers in parentheses refer to Bibliography at end of article.

stabilizers, pigments, and surface-active agents are covered (13).

An article by Schutz gives new information on power and heat balance during extrusion (14). His work indicates that: (a). Most of the energy used in extrusion is consumed in raising the temperature of the plastic; (b). If the specific heat of the plastic is known, the power requirement for extrusion can be calculated; and (c). Loss of heat through moisture stripping must be taken into account in calculating power requirements.

Means of producing cellular vinyl on extrusion and calendering equipment were described by Esagrove and Meyer (15). In the case of low-density materials, the compound containing blowing agent is extruded onto a core material used to support it during passage through an expansion oven. It then passes through a cooling bath and is taken up on a reel. The expansion oven can be by-passed, if expansion at a later time is desired. Operating so that the blowing agent decomposes in the extruder, with expansion taking place upon emerging from the die, gives a high-density material wherein the nitrogen gas from the blowing agent serves as a filler. The unique properties obtained thereby are discussed.

Yoran and Stockman describe the compounding, processing, and manufacture of vinyl foam by the Elastomer Chemical process (expansion of a gas dissolved in a plastisol under pressure) (16). They show the effect of plasticizer concentration on load deflection properties. Test methods for the foam are described and the properties, flame resistance, tensile strength, static charge, and the compression set at high deflection and humid aging are considered in relation to other types of foams.

The advantages and limitations of clay fillers are discussed by Schwartz (17). He relates insulation resistance and stability to the clay used and how it was calcined. The pH-dependent reaction between lead stabilizers and titanium compounds to give gray or black materials is shown to be an important factor in formulating. The oil-absorbence value of the clay is seen as an important consideration in establishing mixing procedures.

The use of ionizing radiation to raise the operating temperature of plasticized PVC in wire-insulation applications has been limited by the impairment of thermal and oxidative stability resulting from the irradiation. It has been shown by Miller (18) that incorporation of a small amount of a tetrafunctional monomer (Union Carbide MG-1) in the composition permits controlled cross-linking by radiation at dose levels which do not affect the stability of the material.

Fluidized coating of PVC was discussed by Russell (19) as an alternative to plastisol dipping where dripping and air entrapment are problems. The finely-ground PVC compound is air-levitated in a container having a porous bottom. The metal object to be coated is heated above the fusion temperature of the resin, and immersed for a few seconds in the fluidized PVC. The technique seems to be particularly useful in coating expanded metal-grille work.

A discussion of high-impact PVC as a pipe material is given by Mottram (20). He develops a favorable economic and property comparison to metal pipe. The problems of PVC pipe extrusion and the molding of fittings are dealt with in a second article. German experience in setting safety factors and maximum allowable stress are available (21). Van der Wal describes tensile-creep measurements on rings cut from PVC pipe (22). His work leads him to an allowable circumferential stress of 1,140 psi. for rigid PVC pipe. A freedom from environmental stress-cracking in such pipe under stresses up to 1,860 psi. is observed over a period of 10 years. The use of PVC pressure piping in chemical installations was reviewed (23). Joining is given particular attention, and proposed ASTM and ASA standards for pipe, fittings, and solvent cement are described. The DuPont specification sets the operating temperature so that one-half the stress required to give 2% creep in 50,000 hours (extrapolated from 10,000 hours) is applied.

A consideration of section extrusion from the standpoint of equipment and economics was given by Burke and Parker (24). An elaboration of this process, which has been given increased attention in recent years, is chopped-section extrusion. As an example, radio cabinet sections might be extruded and chopped into units with subsequent fitting of separately-produced missing faces. This as an alternative to injection molding. The authors see an appreciable development in this area with the development of high-speed cutting equipment and the solution of design problems.

The unexpected trend in properties when less than the usual amount of plasticizer (0-20%) is added to PVC is detailed by Jacobson (25). He visualizes a major new area of application when the qualities of semi-rigid PVC are exploited properly. Jacobson finds that the impact strength goes through a minimum and the tensile strength through a maximum in this range of plasticization while the ultimate elongation shows a sharp rise at about 15% plasticizer content. He interprets these observations in relation to changes in the crystallinity of the resin. On the other hand, Fuchs and Frey (26) believe the phenomena are due to incomplete solvation of the PVC molecules.

Japanese investigators studied the dielectric behavior of vinyl chloride-vinylidene chloride copolymers (27) over a frequency range of $0.1\text{-}10^6$ cycles per second and temperatures from $-23°$ to $+84°$ C. Dielectric dispersion determines the glass-transition temperatures.

Stress relaxation and creep measurements on plasticized PVC were made by Becker (28) at temperatures between 20° and 100° C., and reduced to a single composite curve by an empirical time-temperature shift.

Among the newer vinyls, polyvinyl alcohol is old to the technology, but new in the sense of current, increasing applications. (29). The high tensile strengths of PVA films, their resistance to organic solvents, and their impermeability to all gases except water vapor and ammonia are responsible for this renewed interest. The water solubility of these films has suggested their use in packaging such things as detergents, dry bleaches,

and insecticides, with the product released by dissolution of the package. Poly (vinyl fluoride) was announced in 1959 as a good-weathering, tough, chemically-inert film in the polyester price range. Possible uses were suggested as a paint substitute, and as a substitute for vinyl plastisols in lamination-to-steel; wherein a roll of film would substitute for the plastisol.

Among the machinery developments we might mention is a splicer which can join rigid PVC extrusions with cross-section up to 2- x 1½-inches (Kel-Min. Co.), and the Reifenhauser and LMP (Colombo) machines. The latter produce rigid corrugated sheeting by manipulation of the hot extruded sheet with opposing rods as it traverses the corrugating area on a belt.

Bibliography

(1). H. Frey, "Hostalit Z—A New PVC Compound," **Kunststoffe**, 49, 50 (February 1959).
(2). H. B. Sommers, G. W. Hedrick, F. C. Magne and R. Y. Mayne, "Alkyl Pinonate Plasticizers from Turpentine," **Ind. Eng. Chem.**, 51, 4, 549 (April 1959).
(3). E. W. J. Beaven and D. Liff, "A New Type of Secondary Plasticizer for Polyvinyl Chloride," **Plastics (London)**, 32, 5, 197 (May 1959).
(4). R. S. Stromberg, S. Straus and B. G. Achhammer, "Thermal Decomposition of Poly (vinylchloride)," **J. Poly. Sci.**, 35, 129, 355 (March 1959).
(5). C. H. Fuchsman, "Stabilization of Mixtures Containing Polyvinyl Chloride," **SPE J.**, 15, 9, 214 (March 1959).
(6). C. H. Fuchsman, "Pitfalls in Evaluation of PVC Stabilizers," **Ibid.**, 15, 9, 214 (March 1959).
(7). T. A. Girard and C. F. Koda, "Pink Discoloration of Vinyls," **Modern Plastics**, 36, 10, 148 (June 1959).
(8). N. L. Perry, "Stabilization of PVC Towards Sunlight," **SPE J.**, 15, 7, 550 (July 1959).
(9) N. L. Perry, "Barium-Cadmium Stabilization of PVC," **Rubber Age**, 85, 3, 449 (June 1959).
(10). J. T. Hill and F. Leonard, "Determining Discoloration in PVC Films," **Ibid.**, 86, 1, 97 (October 1959).
(11). H. L. Gunnerson and J. P. Gallagher, "Non-Newtonian Flow Behavior of Vinyl Resin Plastisols," **Ind. Eng. Chem.**, 51, 7, 874 (July 1959).
(12). A. C. Werner, "Organosol Formulations for Stir-in Dispersion Type PVC Resins," **Modern Plastics**, 36, 11, 126 (July 1959).
(13). A. E. Meazy, "Rotational Casting of PVC Pastes," **Brit. Plastics**, 32, 2, 55 (February 1959).
(14). F. C. Schutz, "Some New Verifications of Power and Theory in PVC Extrusion," **SPE J.**, 15, 4, 311 (April 1959).
(15). D. Eserove and R. J. Meyer, "Low-density Cellular Vinyl by Post-expansion Methods," **PLASTICS TECHNOLOGY**, 5, 3, 27 (March 1959); "High Density Cellular Vinyl by Direct Extrusion," **Ibid.**, 5, 4, 32 (April 1959).
(16). C. S. Yoran and R. J. Stockman, "Vinyl Foam," **Rubber World**, 139, 4, 542 (January 1959).
(17). E. W. Schwartz, "Use of Clays in Vinyl Compounds," **PLASTICS TECHNOLOGY**, 5, 7, 31 (July 1959).
(18). A. A. Miller, "Radiation Cross-linking of Poly (vinyl chloride)," **Ind. Eng. Chem.**, 51, 10, 1271 (October 1959).
(19). J. R. Russell, Cleveland RETEC on Vinyls.
(20). S. Mottram, "High Impact PVC as a Pipe Material," **Plastics (London)**, 24, 24 (Jan. 1959); Ibid., 24, 98 (March 1959)
(21). K. Richard and R. Ewald, "Extrapolation, Safety Factors and Maximum Working Pressures Relating to Polyethylene and PVC Pipes," **Kunststoffe**, 49, 3, 116 (March 1959).
(22). A. A. van der Wal, "Allowable Working Stress in Rigid PVC Pipes," **Rubber & Plastics Age**, 40, 21, 156 (February 1959).
(23). F. J. Staudt, "PVC Pressure Piping Comes of Age," **Chem. Eng.**, 66, 11, 115 (June 1, 1959).
(24). G. H. Burke and A. E. Parker, "Section Extrusion of Rigid PVC," **Brit. Plastics**, 32, 3, 120 (March 1959).
(25). U. Jacobson, "Semi-rigid PVC," **Ibid.**, 32, 4, 120 (March 1959).
(26). O. Fuchs and H. H. Frey, "Effect of Small Plasticizer Concentration on PVC," **Kunststoffe**, 49, 5, 213 (May 1959).
(27). S. Saito and T. Nakajima, "Dielectric Behavior of Copolymers of Vinylidene Chloride and Vinyl Chloride," **J. Poly Sci.**, 37, 229 (May 1959).
(28). G. W. Becker, **Kolloid-Zeitschrift**, 166, 1, 4 (September 1959).
(29). R. E. Grandpre, "Polyvinyl Alcohol," **Plastics World**, 17, 16 (March 1959).

—THE END

Heat-resistant encapsulating resins
(Cont'd. from page 50)

In general, all of these resins have good electrical properties for encapsulating applications. For high-frequency applications, where low losses are essential, the polybutadiene and silicone resin are especially suitable.

Conclusions

Many important properties of an encapsulating resin system deteriorate rapidly when the resin is subjected to high temperatures. For epoxy resin systems, the degree of deterioration depends largely on the type of hardener used. There appears to be a direct relationship between the heat-distortion temperature of a resin and its properties at elevated temperature. High H.D.T. resins are more heat resistant than those having low H.D.T. values. They not only tend to retain their room-temperature mechanical and electrical properties at higher temperatures but also are more thermally stable as determined from weight-loss rates at elevated temperatures.

The heat resistance of an encapsulating resin system should not be evaluated on the basis of one property only, but on the results of a combination of thermal tests.

A complete evaluation of a heat-resistant encapsulating resin can only be determined from the product, where it has to meet not only the thermal requirements, but many other requirements as well.

Acknowledgment

Although a number of people have contributed data, special mention should be made of William Picard, William Viscusi, and John Learn of General Electric; C. W. Wolfe, of Phillips Petroleum; K. R. Hoffman, of Dow Corning; J. E. Carey and Peter DeHoff of Shell Chemical; and William Leichtner, of Farnsworth Electronics.

Blow molding

The Blow-Molding Industry has Outgrown Available Information On Plastics.

Edited by:
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IT IS NO LONGER unusual to find a firm engaged in blow-molding either as a part or as the whole of its plastic operation, nor is it a rarity to find a person who can enter into a knowledgeable discussion of blow-molding techniques. No longer are we surprised to find articles in plastics periodicals relating to the equipment, processes, or handling of polyethylene in blow-molding machines.

Unless many people are mistaken, this new industry will continue its unprecedented growth pattern for the next five years. Thus far, the outstanding developments in blow-molding have been brought about by a few far-sighted individuals and corporations. Tomorrow's achievements can fulfill expectations and predictions only if these people maintain their efforts, and are joined by those segments of the industry which now are lagging behind.

The majority of the credit for present accomplishments goes to the major producers of polyethylene. These firms have done much to prove the value of linear or low-density polyethylene in blow-molding. The best example of their efforts, of course, is the acceptance accorded plastic detergent bottles. This program was the result of three years' work, involving laboratory testing, limited production, market testing, and acceptance.

Through their efforts, and those of various machinery manufacturers, we also see polyethylene in a wide variety of toys, dolls, a few industrial applications, thin-walled bags (as liners for cardboard or steel containers), and in bottles other than those for the detergent field.

Polyolefin manufacturers now offer special blow-molding grades, and are continually introducing new formulations designed for the specific requirements of these markets. Although good, these materials will not meet all blow-molding requirements.

We are asked regularly for information concerning the handling of other materials, and about materials which will meet some new requirements. As manufacturers of blow-molding machinery, we have, in cooperation with plastic suppliers, run tests on various materials for our customers, and for our own information as well. I am certain that the other blow-molding equipment manufacturers have run similar tests. A machinery manufacturer, however, cannot spend the time required to classify all of the handling problems and techniques needed to evaluate these materials, nor should he be expected to. This burden must be accepted by the material supplier.

To date, in all too many cases, a customer interested in a specific application has been able to obtain operating information on materials only from machinery manufacturers. Aside from the polyolefin suppliers, few manufacturers have adapted their materials to the requirements of blow-molding. For that matter, many of these manufacturers seem quite uncertain as to what these requirements might be. Their representatives have little, if any, information to pass on to prospective purchasers who require properties which cannot be offered in polyolefins.

Some work is being done with the cellulosics, and this is admirable since they offer many properties which will lend themselves to a number of blow-molding applications. There is very little information available, however, on most of the styrenes, the ABS polymers, and (most regrettably) the vinyls. These latter materials offer a number of excellent properties for products which could be blow-molded, but most of our molders avoid it because of unknown stability and corrosive factors. In Europe and Japan, the vinyls are used extensively in blow-molding. In this country, due to lack of interest or failure to realize their potentials in the blow-molding field, no vinyl manufacturer has undertaken efforts to adapt these materials to blow-molding.

Much the same criticism can be made of the producers of ABS polymers. This material could have a tremendous future with a little work and a little push. Since it is inert to chemicals which readily affect polyethylene, it could open up vast new container markets. These markets could far surpass that much-publicized 200-million pounds annual volume predicted for linear detergent bottles. In fact, they might far exceed the present blow-molding market of all materials.

Besides needing more variety in materials, is a great need for a standard method of material evaluation. Melt index and molecular weights, currently the common reference points in the polyolefin field, are not sufficient for accurate evaluation and selection of a material. This is a serious situation which must be remedied to meet the demands of this ever-growing blow-molding field. In June, I will list details on the requirements for this standardization program which should be undertaken on an industry-wide basis.

—THE END

Injection molding

Variations on hot-runner molding

Edited by:
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The February column attempted to bring into sharper focus some of the more obvious and compelling reasons which might tempt a molder to explore the hot-runner molding technique. To further the reader's understanding of how this technique could fit into his operation, we will touch on some of the variations of the art which are now being practiced.

As we constantly strive to increase the efficiency of the molding operation, it seems that sprue-less molding is really the next logical step to be taken. Those who learn to use the technique with skill and intelligence cannot help but enjoy a distinct competitive advantage over their less-enterprising competitors. For this reason, there is a great deal of interest in the subject of hot-runner molding throughout the industry and it behooves us all to evaluate its potential usefulness in our plant.

There are at least three methods of utilizing hot-runner design features, either totally or in part, with beneficial results. Since temperature control at the gate is the one all-encompassing problem to be licked in these designs, let us look at some of the ways we can approach the problem in the following three methods:

(1). Completely sprue-less molding, wherein the resin is maintained at moldable temperatures right up to the gate orifice. In this situation, the molded parts are ejected completely free of projecting sprues or gate tabs and, ideally, free of any undue blemishes (heat marks and voids) other than the minimal gate mark itself. Such a mold should be capable of being re-cycled immediately and should also be tolerant of any reasonable cycle interruptions without gate freeze-ups. Obviously, such a mold would provide, very nearly, the ultimate in efficient operation. As you might suspect, this sort of mold is the most difficult hot-runner type to design and equally touchy to run, particularly in multiple-cavity work. However, this method has been used extensively in single-cavity molds with relative ease and excellent results.

(2). Multiple nozzles with individually-served cavities. This arrangement often is useful for molding tubular objects or parts with a hole of ¼-inch diameter or larger molded through as part of the product design itself. Here, the mold designer is able to bring the heated sub-nozzles into register with the molded hole in the product, creating a very tiny sprue and tunnel gate system within the confines of the aforementioned molded hole. Of course, this miniature sprue would be ejected and sheared from the molded product in the usual manner. These sub-sprues hardly exceed ½-inch in length, so this design provides an efficiency very close to that of the 100% sprue-less variety. In return for this loss in efficiency, we are able to design and build a hot-runner system which is much less critical to control temperature-wise and, therefore, is easier to operate to produce high-quality parts. This sub-sprue approach can also be used with equal facility for side-gateing of objects that are suitable.

(3). Multiple nozzles. This arrangement is most useful for applications involving multiple cavities in molds that also are physically large. Here, we employ a completely conventional runner system or, rather, a group of sub-runner systems each being fed by its own sub-nozzle through a hot-runner manifold. Thus, a 64-cavity mold might be arranged with 16 sub-nozzles, each feeding a group of four cavities. Obviously, this four cavity group will be far more uniform in ejection pressure, packing, and gate balance than if the cavities were being fed from a remote single nozzle through a maze of runners, as would be the case in conventional molding. The chief advantage of these multiple-nozzle designs is the reduction of the severe pressure drop usually associated with an extensive runner system in conventional molding because of faster mold filling rates and a reduction of over-packing of the cavities in close proximity to the nozzle. Very large objects, such as refrigerator door liners and the like, are now usually molded with multiple nozzles for the very reasons noted above. Hence, it is worthwhile for us to consider adopting this system also for our multiple-cavity work.

From the examples cited above it becomes apparent that many of the advantages of the hot-runner technique can be realized with a minimum of risk of mold malfunction if the mold designer, tool maker, and molder are content to build-up their store of experience in this art on something other than completely sprue-less molding.

—THE END

PLASTICS TECHNOLOGY

EXPLORING FABRICATION TECHNIQUES

By L. J. ZUKOR, *Engineering Editor*

Vinyl Extrusion.

• Why do some plastics fabricators enjoy favorable plant operating conditions, while others encounter untold difficulties in the same type operations?

• How related is know-how to ingenuity and inventiveness?

I learned a good deal about vinyl extrusion operations on a recent visit to The Borden Chemical plant in North Andover, Mass. Herb Erickson, Operating Manager of the Resinite Department, pointed out their quality control set-up, stressing the fact that an efficient, continuous check was the only way to keep quality high and rejects low. (See our May 1959 issue, page 66). The quality control group operates an optical comparitor to check cross-section dimensions of extrudate. It also has access to a physical testing laboratory in which periodic checks are run on tensile strength, elastic limits, and compound evaluation.

I noticed that the extruders were set adjacent to a service wall, which contained main pipe lines and power cables. This permits short drops to individual machines. Windows along this wall draw off the heat directly and there is little heat dissipation to other areas. A complete reclamation unit along this wall converts high grade scrap to usable material. It consisted of a Banbury mixer which fed a two-roll mill. Strip from the mill was fed directly to a sheet extruder, which operated with a full screen pack to ensure against inclusion of degraded stock or abrasive substances in the extrudate. After cooling, the heavy strip was fed into a pelletizer from which the vinyl pellets were air conveyed to storage. Interposed between the pelletizer and the storage containers was a shaker screen for sizing the pellets.

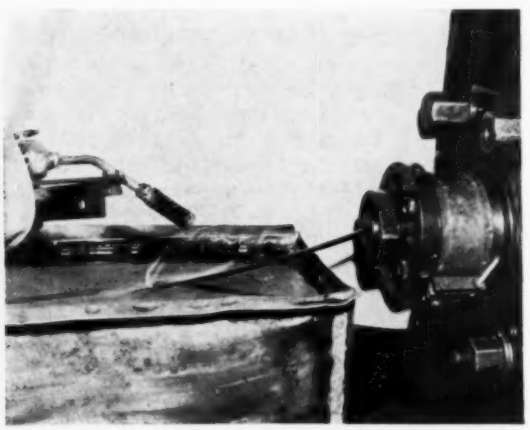


Photo courtesy: The Borden Chemical Co.

Flame polishing vinyl strap-stripping.

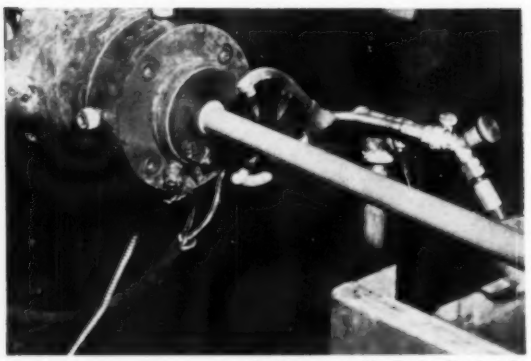


Photo courtesy: The Borden Chemical Co.

Flame polishing garden hose.

The main manufacturing area had a battery of extruders, some sharing a common die head and at 90° angles to each other. Others were "in-line" set-ups that could be quickly changed over from making tubing to a set-up for extruding welting. One machine was extruding vinyl strap-stripping for the shoe industry to replace patent leather straps in women's and children's shoes. Gloss identical to that of patent leather was produced by an ingenious simple jig arrangement using a flame to polish the extrudate prior to quenching.

A burner of different design was used to flame-polish the outer covering of non-reinforced garden hose. Flames from the burner cover the complete periphery of the hose but, as can be seen in the photo, the Y-shaped burner permits a greater freedom of action than that allowed by a circular fixture in which the tubing must be threaded through the opening. Flame polishing might also work well on linear polyethylene pipe that tends to have a dull finish after being extruded. (See our Jan. issue, page 52.)

In another area, I was shown into a closed room where medical tubing was being manufactured. This room, isolated from contamination, was kept free of extraneous equipment. To further insure against contamination, the tubing was weighed and packed in the same surroundings.

Upon my return to the laboratory, I noticed some experiments being performed on dilating thick-walled

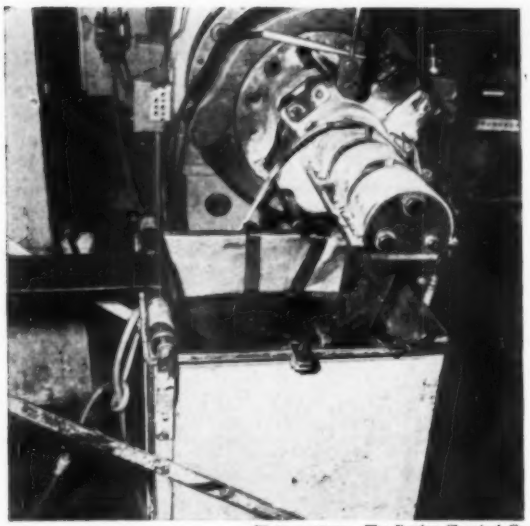


Photo courtesy: The Borden Chemical Co.

Scrap extrusion prior to regrinding.

vinyl tubing. I compared a handle coated by conventional plastisol dipping with one on which dilated tubing was placed and dried. It seemes to me that the dilated tubing method has a great advantage over the multiple dipping operations required for heavy plastisol coating. Vinyl materials swell in non-polar solvents like dichloroethylene. Soaking in this solvent causes tubing to expand appreciably in both inside and outside diameters.

The expanded tubing can be slipped easily over the assembly to be covered and, when dried, shrinks down to a very tight fit. Drying is effected by evaporation of the solvent and it is conceivable, in production, to reclaim the solvent from the vapor stage as it emanates from the vinyl. Forced draft ovens can be used to accelerate solvent discharge. Although the vapors will burn on contact with an open flame, the vapor and liquid will not of themselves support combustion.

I should mention that a small amount of plasticizer is leached by the solvent during the swelling of the vinyl. This, in effect, changes the physical properties of the finished piece. Knowing this, it is possible to formulate a vinyl compound with a slight excess of plasticizer to balance that removed by leaching.

The general arrangement of this plant is such that no modification of layout has to be made when a great variety of items is to be manufactured. For instance, the same set-up used to extrude an inner core and outer covering on hose can also be used for two-color extrusion of shapes or tubes. With the addition of other more portable equipment, wire covering and flat metal strip inclusions can be run readily on the in-line extruding machines.

•

Volumetric Feeders . . .

. . . used for many years in the chemical processing industry, have recently been redesigned and sized to service hopper-fed plastics machinery. This new means for adding color to "natural" PVC has been tested and proven for extrusion at the Ambridge, Pa., plant of National Electric Division, H. K. Porter Company.

The firm produces PVC-insulated copper wire called thermoplastic waterproof (TW), in sizes ranging from No. 14 to 500 MCM. PVC thickness varies accordingly. In addition to white and black, there are demands for colored TW wire—red, blue, green, purple, orange, etc. These allow ready identification of several wires distributed through a common duct.

National Electric formulates its own black and "natural" (off-white) PVC from the basic resins, and adds color chips to the "natural" PVC. These rather costly chips of varying size are a mixture of an organic dye in a low molecular weight vinyl copolymer. A density of 1% (one lb./100 lbs. PVC) is required to produce a uniform color tint, which must be maintained from reel to reel.

Formerly, color chips were added by tossing approxi-

(Continued on page 62)

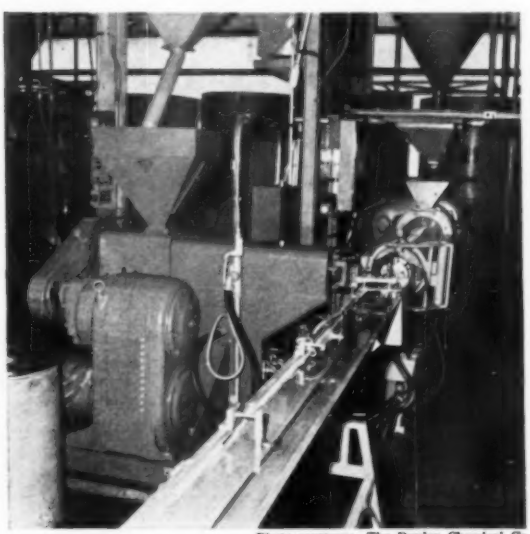
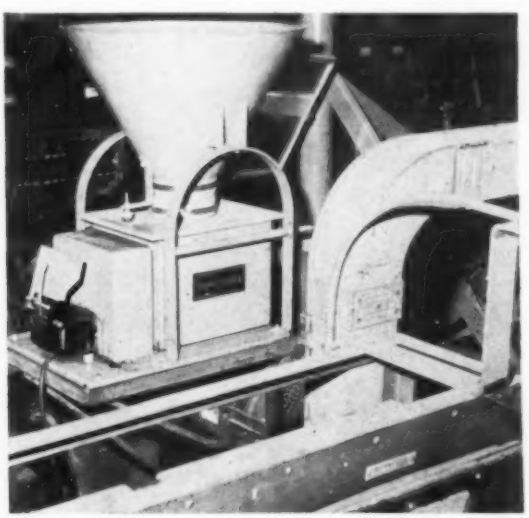


Photo courtesy: The Borden Chemical Co.

Machinery arrangement adjacent to service wall.



Color chip feeder arrangement.

HERCULES

Plastics Hi-Lites

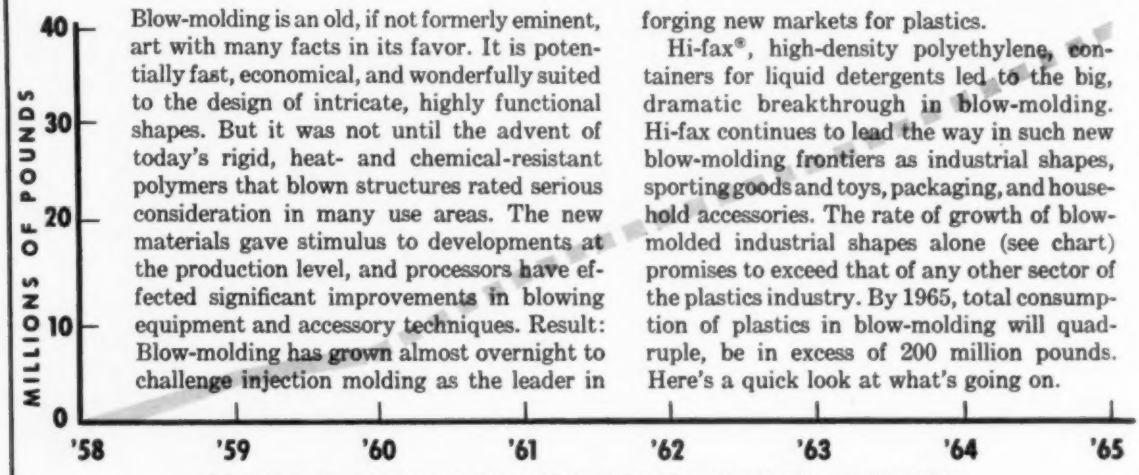
Vol. II, No. 2

Blow-Molding challenges injection

As blown containers move full steam ahead, engineers see sizeable new markets for many types of blown structures.

Blow-molding is an old, if not formerly eminent, art with many facts in its favor. It is potentially fast, economical, and wonderfully suited to the design of intricate, highly functional shapes. But it was not until the advent of today's rigid, heat- and chemical-resistant polymers that blown structures rated serious consideration in many use areas. The new materials gave stimulus to developments at the production level, and processors have effected significant improvements in blowing equipment and accessory techniques. Result: Blow-molding has grown almost overnight to challenge injection molding as the leader in forging new markets for plastics.

Hi-fax®, high-density polyethylene, containers for liquid detergents led to the big, dramatic breakthrough in blow-molding. Hi-fax continues to lead the way in such new blow-molding frontiers as industrial shapes, sporting goods and toys, packaging, and household accessories. The rate of growth of blow-molded industrial shapes alone (see chart) promises to exceed that of any other sector of the plastics industry. By 1965, total consumption of plastics in blow-molding will quadruple, be in excess of 200 million pounds. Here's a quick look at what's going on.



PROJECTED GROWTH OF BLOW-MOLDED INDUSTRIAL SHAPES

(1965 consumption of all forms of blow-molding will be in excess of 200 million pounds)

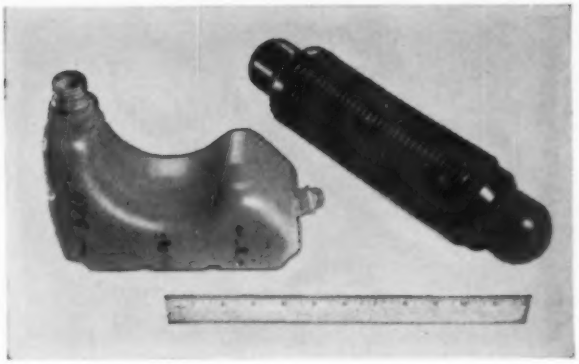
HOLD EVERYTHING?

WELL, NOT QUITE

The leading and pioneer material among the new polymers used in blow-molding is Hi-fax, high-density polyethylene. Hi-fax bottles are continually undergoing torture testing at the Hercules Plastics Applications Laboratory, where hundreds of candidates for plastics packaging have been checked out (see cut). Hi-fax won't package everything, and such testing has pointed up the few instances where the product was not compatible with plastic containers. No other high-density material has such an extensive exposure history either in the laboratory or in actual commercial use.

INDUSTRIAL SHAPES

Advanced automotive engineering concepts such as these point the way to tremendous growth in the use of Hi-fax for blown industrial shapes. The complex shape of windshield solution container (left) makes it possible to utilize former under-the-hood waste space in a compact car. Built-in bellows feature of high-density heater duct (right) provides a flexible, low-cost part adaptable to rapid, economical assembly. Both parts exemplify the fine combination of properties and processability offered by Hi-fax blown structures.



SPORTING GOODS AND TOYS

Blow-molded Hi-fax shapes offer the short, fast, low-cost route to the production of readily merchandised sporting goods and toys. Lifelike realism achieved in the duck decoy shown at left is typical of the effects possible with Hi-fax. Exciting new surface textures, excellent mold detail reproduction, and a broad color spectrum, combined with lightweight toughness, in a pleasant-to-handle, nontoxic material, make blown Hi-fax shapes a natural for these fast-moving, highly competitive markets.

DRUGS AND COSMETICS

Hi-fax has greatly broadened the horizons of designers of blown containers. Its combination of rigidity and chemical resistance now permits the use of plastic packages for a wide variety of drug and cosmetic products in exciting new shapes. Unique "Whitey the Whale" container in background holds bubble bath solution; later will serve as an appealing toy. Hi-fax blown shapes are ideal for secondary use and premium packages, at down-to-earth prices competitive with metal and glass.

HOME AND OFFICE

This handsome group of lampshades is a good example of the interesting and pleasing blown shapes which can be achieved in home and office accessories. Hardware, housewares, machine housings and decorative fittings are all fields where the esthetics and economy offered by Hi-fax blow-moldings must prompt their immediate consideration by all forward thinking producers.

Want more information about blow-molding? Look to the leader and pioneer in this field. Call or write:

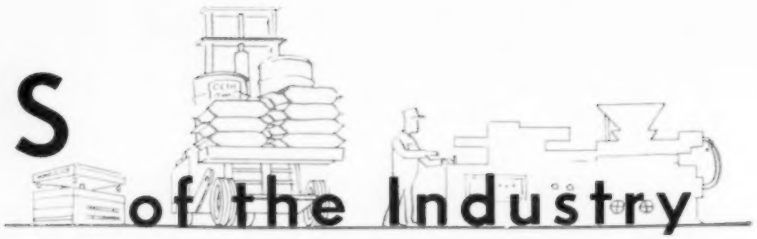
HERCULES POWDER COMPANY
INCORPORATED
900 Market Street, Wilmington 99, Delaware

HERCULES

THREE NEW MATERIALS FOR THE PLASTIC INDUSTRY

HI-FAX® HIGH-DENSITY POLYETHYLENE • PRO-FAX® POLYPROPYLENE • PENTON® CHLORINATED POLYETHER

NEWS of the Industry



agents, distributors & agreements

Plastic Molders Supply, Inc., Fanwood, N. J., has appointed S. L. Abbot Co. its distributor in southern California. The Los Angeles Firm is located at 4255 District Blvd.

Food Machinery & Chemical Corp.'s Becco Chemical division has issued its first license for the in-situ epoxidation process to Reichhold Chemicals, Inc. This process was described last month in "What's New in Processing", page 18.

changes in corporate name

International Molded Plastics, Inc., has changed its name to Brookpark, Inc. The new office building is located at 11701 Shaker Blvd., Cleveland 20, O.

Isochem Resins Corp., Providence, R. I., has changed its name to Isochem Resins Co. Officers remain the same, and A. L. Smith, Jr., has been added to the staff as plant manager.

changes in ownership, new companies

W. R. Grace & Co. has acquired 1,580,000 shares of Cosden Petroleum common stock, slightly over 51% of the outstanding shares. Cosden is currently erecting facilities which will triple its styrene capacity to 60-million pounds annually.

Brunswick-Balke-Collender Co., Chicago, has purchased Owens Yacht Co., Inc., Baltimore, Md. The latter firm will operate as a division under present management. Other Owens plants are located in Tell City, Ind., Tustin, Calif., and Nampa, Idaho.

Ferro Corp. has purchased Vitro Mfg. Co., the Pittsburgh division of Vitro Corp. of America, for approximately a half-million dollars. The latter manufactures glass and overglaze colors, glaze stains, and porcelain enamel oxides.

Key Polymer Corp. is a new firm producing epoxy and urethane adhesives and coatings. Formed by J. Lichman, S. Comins, and A. Comins, the company is located at 135 Bradford St., Lawrence, Mass.

Princeton Chemical Research, Inc., has been founded by Calvin N. Wolf, former manager of research for Petro-Tex Chemical Corp. The new organization will specialize in petrochemicals, polyolefins, and catalysis. A plant was recently constructed in Princeton, N. J.

Texstar Corp., San Antonio, Tex., has bought Air Accessories, Inc., Fort Worth manufacturer of plastic glazing, aircraft bubbles, and marine windshields. The firm will operate as a subsidiary under the name Texstar Plastics.

Farrington Mfg. Co. has acquired the coated fabrics division of Sawyer-Tower, Inc., Watertown, Mass. Farrington is located in Needham Heights.

Metachem Resins Corp. has been organized to supply epoxy and polyester formulations. Located in Cranston, R. I., the new firm will be presided over by Herbert L. Spivack, formerly of Isochem Resins Co.

business developments

Injection Molders Supply Co. has made available heating cylinders for the Reed-Prentice 10D8, 175-T, and 275-T injection machines on a "loan rental basis."

Dow Chemical Co. has formed a new division, the Saginaw Bay division, which will incorporate the petrochemicals plant, the polychemicals area, and the Bay Refining Co.

Goodyear Tire & Rubber Co. has discontinued production of all its rubber flooring lines and will concentrate on vinyls exclusively.

Monsanto Chemical Co. has doubled its capacity for producing Lytron 680, an acrylic-type binder for general purpose outdoor latex paints at Addyston, O. Added facilities in Santa Clara, Calif., will triple output of the material at that plant.

Montecatini is bringing polypropylene fibers to the United States in sample quantities. The continuous multi-filament yarn is called Meraklon.

Johns-Manville has purchased the assets of Franklin Plastics, Inc., Franklin, Pa., manufacturer and distributor of extruded plastic pipe.

Continental Can Co. has set up a plastic bottle and tube division, with headquarters in Chicago. Charles F. Lenhard has been named to head the division.

Allied Chemical Corp. has obtained approval from the Food & Drug Administration for Elastex 28P and Elastex 10P as plasticizers in food packages and containers enclosing high water-content foods.

Celanese Chemical Co. has developed a new process for stabilizing formaldehyde which makes it possible to reduce storage temperatures by 15-20° F.

Dow Chemical Co. has formed a new subsidiary, Dow Chimica Italiana, S.p.A., with headquarters in Milan. A multimillion dollar manufacturing plant will be erected to produce the entire Styron line, as well as other products.

Dow Chemical Co. plans to increase its styrene monomer capacity to more than 800 million pounds per year. Completion is expected this winter.

Plastic & Rubber Products Co., Los Angeles, Calif., has formed a fluorocarbon division, with headquarters in Gardena. This division will process nylon and polyethylene as well as Teflon and Kel-F.

Filon Plastics Corp., Hawthorne, Calif., has expanded its line of translucent reinforced-plastic building panels to 19 colors, 21 configurations, and six weights.

Mitchell Plastics, Inc., Pittsburgh, Pa., has undergone reorganization and is now equipped to design and make plastic test models as well as machine, engrave, weld, form, blow mold, and process equipment.

Dow Chemical Co. plans to expand its polyethylene capacity at Freeport, Tex., by approximately 67%. Completion is expected in 1961.

new plants, labs & additions

Tronomatic Machine Mfg. Corp. has moved its facilities to 25 Bruckner Blvd., Bronx, N. Y. Substantially larger than previous quarters, the plant contains 30,000 square feet of available space. The firm manufactures packaging and plastic forming equipment.

Dumont Mfg. Corp., a Dutron subsidiary, has completed new facilities adjoining its manufacturing complex in San Rafael, Calif. The firm compression molds missile components.

Grieve-Hendry Co., Inc., has moved to new quarters at 1350 N. Elston Ave., Chicago. The firm makes industrial and lab ovens and furnaces.

Food Machinery & Chemical Corp.'s Becco Chemical division has begun construction of a distributing center in Lyndhurst, N. J., to replace the present one in Jersey City. It will be larger, and is more conveniently located.

Union Carbide Plastics Co. has moved its Texas district sales office to 6300 North Central Expressway, Dallas.

Department of Defense has established a plastics technical evaluation center at Picatinny Arsenal in Dover, N. J. The center will be operated by the U. S. Army Ordnance Corps, under the direction of Harry E. Pebly.

Allied Chemical Corp. has begun construction of a high-density polyethylene plant in Orange, Tex., adjacent to the ethylene derivative plant operated by the firm's nitrogen division. Completion is scheduled for late this year.

Radio Frequency Co., Inc., Medfield, Mass., has initiated construction of an addition to its present plant. The new wing will house research and development facilities.

Barium & Chemicals, Inc., Willoughby, O., recently purchased a 165,000 square foot plant at Steubenville, O. The present plant will continue operations.

Studebaker-Parkard Corp.'s CTL division plans to erect a high-temperature and structural plastic component plant in Santa Ana, Calif. It will have an initial module of 20,000 square feet.

Dow Chemical Co. has chosen Kalama, Wash., as the site for its new phenol plant. Completion is expected by mid-1961.

American Cyanamid Co.'s plastics & resins division plans to move its executive offices to Wallingford, Conn., late this summer.

Filon Plastics Corp. recently opened a $2-million plant in Hawthorne, Calif. The 72,000 square foot facility will produce nylon- and fiberglass reinforced plastic panels.

Mount Hope Machinery Co., Taunton, Mass., has begun construction of a new plant in Charlotte, N. C. Completion is scheduled for this spring.

Polymer Industries, Inc., recently completed a $500,000 industrial adhesives facility at Springdale, Conn., and has scheduled a $500,000 polymerization and solvent-mixing plant on the same grounds.

W. R. Grace & Co. is currently building a 50,000 square foot plant for the production of packaging machinery to be used by the Cryovac division. It should open in early June.

B. F. Goodrich Chemical Co. has initiated construction of a vinyl resins plant in Watson, Calif. Completion is slated for the second quarter of this year.

Koppers Co., Inc., formally opened its sandwich building-panel plant in Detroit, Mich. These panels feature cores of expanded Dylite polystyrene.

Hooker Chemical's Durez division has a new sales office at 333 West First St., Dayton, O. George A. Shroyer is district sales manager.

J. O. Ross Engineering division, Midland-Ross Corp., recently completed new offices at 13050 Puritan Ave., Detroit, Mich.

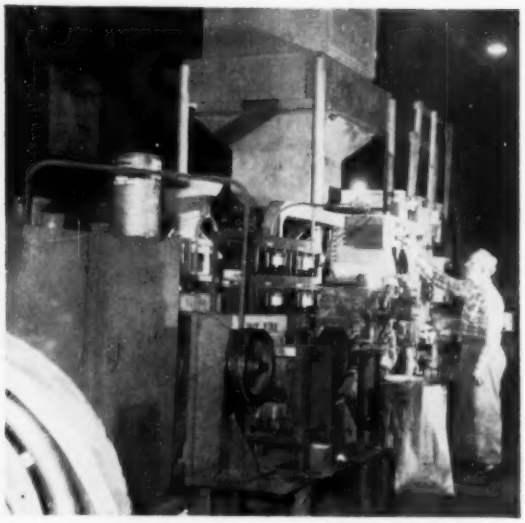
news from abroad

Belgium. S. A. Roll d'Herstal, located in the town of that name, is marketing plastic ball and roller bearings for guiding belt conveyors.

Australia. Winner at the Victoria Plastics Week contest for a new use of plastics went to a reinforcing polystyrene chair (we call them saddles) used to support reinforcements in concrete for the building industry. Second prize was awarded for a 26 by 18 by 11 inch polyethylene hamper, said to be the largest household article produced "Down-Under" to date. A local firm produced a welding mask of opaque reinforced plastic. The inside is lightly sandblasted and sprayed with black nitrocellulose lacquer to prevent penetration and reflection of light. Official estimates of plastics production were 22,000-24,000 tons, a 40% increase over the previous 12 months. Australia imported about 8,000 tons during that period.

(Continued on page 62)

PT Exploring Fabrication Techniques
(Cont'd. from page 57)



Wire extrusion set-up using a volumetric feeder.

mated amounts into a 250 lb. drum of "natural" PVC, followed by tumbling. Distribution of color was uneven and 1/3 more chips were added to prevent "fade-out". This was not only a needless expense, but lead to varying tint density and dielectric strength.

N.E. installed a volumetric dry-materials feeder. Metering by volume, the feeder supplies a predetermined amount of dry material to a batch either continuously or by programmed cycles. It employs density control and uses vibratory flow to assure complete filling and emptying of the measuring elements. Design eliminates air entrapment, and permits dust-free operation.

The measuring element is a screw, which is completely filled through continuous vibration. Speed and feed settings are made by micrometer adjustment, dial-calibrated to 400 divisions.

PVC is loaded into a 750 lb. hopper arranged to feed the dry batch in a desired volume per time period, depending on the speed of the conductor moving through the die and the thickness of insulation required. It drops into a vibrating trough, then into the extruder throat.

Below the hopper, positioned directly above the vibrating trough, is the feeder, with the discharge of the screw directly in line with the moving stream of PVC. Color chips are loaded into the hopper, and the micrometer adjustment controls are set for desired speed and density of flow. The chips drop into a surge hopper which forms the trough of the screw.

As the material enters the extruder, it is exposed to heat and fused into a homogeneous colored mass of relatively low viscosity. The extrudate emerges from the die concentric to and at the same velocity as the wire upon which it is deposited.

Volumetric feeders, one per extruder, are saving National Electric over $5,000 a year in color chips and labor costs formerly involved in blending.

—THE END

News of Industry
(Cont'd. from page 61)

news from abroad

China. The Chinese chemical industry is concentrated mainly in the coastal towns, though small plants have sprung up in almost all provinces. Sweet potatoes are used to produce ethylene, and 20 million tons are said to yield a million tons of ethylene. PVC, PVA, and furfural-based plastics are manufactured, and a plant is being erected in Peking, which will have an annual PVC production of 40,000 tons. Target for the second five-year plan is 100,000 tons of fiber and 200,000 tons of plastic.

Netherlands. Production of synthetic phenol is scheduled for late this year. A plant is being erected for Koninklyke Zwavelzuurfabrieken v/h Ketjen, and the output will go partly into the manufacture of phenol derivatives with the rest available on the Dutch market.

Spain. Production of plastics for 1958 was quoted at 11,000 tons, as opposed to 8,800 tons the previous year. Per capita consumption was about two pounds. There were 1,100 establishments employing 25,000; equipment included 2,000 injection molding machines, 500 extruders, eight calenders, and 75 deep-drawing units. About 1,300 machines of all kinds have been built locally in the past three years.

Russia. Polymeric semi-conductors have been developed in Russia, according to recent reports. Polyacrylonitrile has been rendered conductive by ionizing radiation (like germanium and silicon), and has been combined with siloxane for a semi-conductor.

Japan. Mitsubishi Petrochemicals, Showa Petrochemicals, and Furukawa Chemical Industry Co. have entered the polyethylene producing field. This brings the total to five, the others being Sumitomo Chemical and Mitsui Petrochemicals. Also in Japan, a firm is making freight cars with sliding reinforced-plastic roofs. Another company produces accordion-type folding PVC partitions. Osaka Kinyoku Kogyo Co. has developed a PVC/fluorocarbon material for the manufacture of rigid pipe. Sekisui Chemical Co., a PVC foam producer, plans to turn out 100 tons of polystyrene foam pellets per month. Epoxies are not yet produced in Japan, but Shell is expected to license certain petrochemical interests in the near future. Professor Motosato of Kumamoto University has developed an ion-exchange fiber which could serve as a catalyst in chemical reactions . Woven into cloth, it could remove ion particles. Yawata Steel Co. has introduced a PVC/steel laminate called Artbond. Several other firms are expected to follow suit. Professor T. Hoshino of Tokyo Industrial University has applied for a foamed polyurethane patent which is said to be an improvement over the Bayer process. Toyo Rubber Co., Bridgestone Tire, and MTP Kasei have made arrangements to produce urethane foam.

Names in the News

Harold D. Hulterstrum

Flambeau Plastics Corp. has announced four executive appointments. **Harold Adams** has been named director of Sales of the Flamboware division. **Harold D. Hulterstrum,** new director of research and development, has spent eight years in the engineering department. He is succeeded as chief engineer by **LeRoy W. Mason,** who was previously associated with W. A. Schaeffer Pen Co. **Eugene C. Anderson** has been employed as plant superintendent at Flambeau's new subsidiary, Peerless Plastics. He last served as foreman of the injection molding department of Owens-Illinois Glass Co.

Robert J. Stevens has been made a member of the research department of Monsanto Chemical Co.'s Plastics Division at Springfield, Mass. He previously worked for American Cyanamid Co.

George P. Archer has been named manager of Killingly Division, Rogers Corp., and **Roy A. Rosen,** chief tool and die engineer. Mr. Archer had represented the company as a sales engineer in the Cleveland-Pittsburgh area, while Mr. Rosen had been with Precision Tool & Die Co. **Lee Hennessy,** formerly of Vernay Laboratories, has joined Rogers as a market development engineer.

Alan J. Breslau and **Jack Dunnous** have been appointed to the technical staff, and **Wilson B. Green** and **Emil G. Marcmann** to the sales force, of Mitchell Specialty Division of Industrial Enterprises, Inc. Before becoming technical director, Mr. Breslau was in charge of urethane foams and epoxy resins at Thiokol Chemical Corp. and responsible for Essex Rubber Co.'s rubber reclaim plant. Mr. Dunnous, director of systems development, process equipment department, had been a member of the Massachusetts Institute of Technology research group working on missile controls and computer systems. Mr. Green was appointed district sales manager for Indiana, Kentucky, and Ohio, while Mr. Marcmann was named sales representative for New Jersey and Pennsylvania.

Don Singer and **Ben Winston** have been appointed to positions in the sales department of Tri-Point Plastics, Inc. Mr. Singer, formerly assistant general manager and purchasing agent for Silicone Insulation, Inc. and Walter Lee Chemical divisions of Emerson Plastics Corp., is special assistant to the director of sales. He will handle special national sales assignments of Teflon and Teflon products. As a member of the company's eastern division Teflon sales, Mr. Winston will be responsible for industrial sales in New York City and Long Island. He was formerly sales manager for Tri-Point's electronics division in metropolitan New York.

Julius Goltz has been assigned to the newly-created position of sales and development for Bruce Molded Plastic Products, Inc. He had been in sales management with Pittsburgh Broadcasting Co.

Marvin Levine has been named director of research and development of General American Transportation Corp.'s plastics division. He will be located at the E. Chicago, Ill., laboratories, where he has been assistant director for the past three years.

Allan B. Black has been named technical sales representative for Rona Pearl Corp. Recently with the sales department of Ansbacher-Siegle Corp. Mr. Black will service New York City and Long Island.

Raymond H. Marks

Raymond H. Marks, vice president in charge of sales for Cary Chemicals, Inc., has been moved up to executive vice president. His new duties will include coordination of all manufacturing, research, and sales activities. Prior to joining Cary, he was associated with Monsanto Chemical Co., Inc., in various research, production and sales capacities.

Emil J. Kleiner has been named manager of injection molding operations at Haveg Industries, Inc.'s Taunton division.

Charles F. Siebold

Charles F. Siebold has been appointed production manager of the plastics division, Lockard Tool & Engineering Co., where he will supervise production of fiberglass-reinforced polyesters, phenolics, silicones, and epoxies for the aircraft, missile, and electronics industries. He last worked in plastics fabrication at Aerojet-General.

OBITUARY

Kenneth A. Spencer

Kenneth A. Spencer, chairman of the board and founder of Spencer Chemical Co., died on February 19 in Miami Beach, Fla. Death was caused by complications following a heart attack he suffered while concluding a vacation cruise.

Spencer Chemical Co. began as a government-owned synthetic nitrogen plant in 1941. Mr. Spencer and Pittsburg and Midway Coal Mining Co., of which he was president when he died, organized a subsidiary, Military Chemical Works, which constructed and operated Jayhawk Ordnance Works for the War Department. In 1946, the plant was purchased from the government, and Spencer Chemical Co. commenced commercial peacetime operations. The company presently owns six plants which produce, among other materials, polyethylene, nylon, and polypropylene resins for the plastics industry.

Among other industrial and business activities, Mr. Spencer served on the board of directors of American Telephone and Telegraph, Armco Steel, Goodyear Tire and Rubber Co., International Harvester Co., National Coal Association, and Missouri-Kansas-Texas Railroad Co. He was a member of the Business Advisory Council of the Department of Commerce, and a trustee of the Committee for Economic Development. He founded and served on the board of governors of Midwest Research Institute in Kansas City.

In 1943, Mr. Spencer received a citation from the University of Kansas, for outstanding contributions to the University. Baker University and Park College have awarded him honorary degrees.

John A. Stapp, Jr., died on February 18 at his home in Tonawanda, N. Y. at the age of 38. He had been chief technical service representative, fluids, for silicones division, Union Carbide Corp., Tonawanda, N. Y.

A native of Dayton, O., Mr. Stapp joined Union Carbide Corp. at its Speedway, Ind., laboratory in 1948, immediately after receiving a B. S. in chemical engineering from the University of Cincinnati. In 1950, he was transferred to Tonawanda to engage in silicones research and development.

Specializing in polishes for furniture and automobiles, and in the use of silicones in the glass industry, Mr. Stapp had delivered and published many papers on these subjects. Last November he addressed the Canadian Manufacturers of Chemical Specialties Association in Toronto, and in December, the twentieth Conference on Glass Problems at the University of Illinois.

CIGARETTE FIRE DESTROYS BUS
Loss Set At $7,500 In Hackensack Blaze
Hackensack — An Inter-City bus parked at the company's Passaic Street terminal was destroyed last night in a raging fire caused by a lighted cigarette left on a seat of the vehicle.
A spokesman for the company said the $7,500 bus was a total loss.
Engine Company 5 of the Fairmount Station responded to an 8:24 P. M. call, and had the fire under control in 20 minutes. Dep-

Photo courtesy Bergen Evening Record, Hackensack, N. J.

Add flame-resistance to your plastics with CELANESE PHOSPHATE PLASTICIZERS

Celanese plasticizers do much more than impart fire-resistant characteristics:—they provide rapid solvation with most resins, assure permanence, are resistant to extraction by oils and water. Celanese gives you four different grades of tricresyl phosphate: low color, low specific gravity, general purpose, and electrical grades. Celanese chlorinated phosphate plasticizers are outstanding for flame retardance. They are often used as additives in thermosetting plastics for their fire-retardant properties alone. For information on Celanese phosphate plasticizers, write to: Celanese Chemical Company, a Division of Celanese Corporation of America, Dept. 564-D, 180 Madison Ave., N. Y. 16. Celanese® Lindol® Celluflex® Celluphos®

- **LINDOL:** Tricresyl phosphate. Low color.
- **CELLUFLEX 179A:** Tricresyl phosphate. Low specific gravity.
- **CELLUFLEX 179C:** Tricresyl phosphate. General purpose.
- **CELLUFLEX 179EG:** Tricresyl phosphate. Electrical grade.
- **CELLUFLEX 112:** Cresyl diphenyl phosphate. Improved low temperature performance.
- **CELLUFLEX TPP:** Triphenyl phosphate. For cellulose acetate.
- **CELLUPHOS 4:** Tributyl phosphate. For nitrile elastomers.
- **CELLUFLEX CEF:** Tris (beta-chloroethyl) phosphate. Exceptional flame resistance. Chlorinated.
- **CELLUFLEX FR-2:** Tris (dichloropropyl) phosphate. Exceptional flame resistance. High chlorine content.

Canadian Affiliate: Canadian Chemical Company Limited, Montreal, Toronto, Vancouver
Export Sales: Amcel Co., Inc., and Pan Amcel Co., Inc., 180 Madison Ave., New York 16.

Celanese CHEMICALS

New Materials

For more information check Readers' Service Card (p. 87)

Polycarbonate Resin

For applications requiring a material with exceptionally high impact resistance, excellent dimensional stability, and greater resistance to heat, moisture, and weathering than most thermoplastics, Mobay Chemical Co. is introducing commercially a polycarbonate resin. Designated Merlon, the polycarbonate can be processed by most conventional methods without the addition of plasticizers.

When molded, this self-extinguishing resin has a brilliant surface gloss and is transparent, odorless, tasteless, and non-staining. Merlon can be made into shapes, rods, tubes, sheet, and film. Polycarbonate products can be machined, sawed, stamped, solvent-bonded, and heat welded or heat sealed.

In fabricating electrical components, Merlon's low moisture absorption, high dielectric and mechanical strength, and dimensional stability are described as being especially advantageous. Among experimental applications of the resin are insulators, cable wrapping, capacitors, distributor caps, and telephone sets.

Chemically, Merlon is a linear aromatic polyester of carbonic acid. Typical properties follow.

Impact strength, Izod, notch ½x½-in. bar, ft.lb./in. notch	2-3
Tensile strength and yield point, psi	8,000-9,000
Compressive stress at yield point, psi	12,000
Deformation under load, %	0.14
Flexural strength, psi	11,000-13,000
Modulus of elasticity, tension, psi	$2.8\text{-}3.2 \times 10^5$
Flexural, psi	$3.2\text{-}3.4 \times 10^5$
Hardness, Rockwell R	115
Dielectric constant, 60 cycles	2.95
10^6 cycles	2.90
Dielectric strength, short time, v/mil	440
Dissipation factor, 60 cycles	0.0007
10^6 cycles	0.0100
Volume resistivity, dry, ohm/cm	1.2×10^{16}
Four days @ 80% relative humidity, ohm/cm	9×10^{14}
Arc resistance, sec.	12
Heat distortion, °F., 264 psi	280
66 psi	290
Specific heat, cal./°C./gm.	0.28
Thermal expansion, in./in./°C.	7×10^{-5}
Melting temperature, °F.	425-440
Crystalline melting temperature, °F.	505
Specific gravity	1.20
Refractive index, N_D, 25° C.	1.587
Water absorption, 24 hr. immersion, %	0.3

Readers' Service Item 1

Polyester Gel Coats

Whitehouse Chemical Co. has announced the development of a standard line of gel coats, thixotropic pigmented polyesters for both spraying and brushing. These thick, putty-like materials, in ten colors, are offered in both accelerated and non-accelerated mixtures. The accelerated type contains cobalt activator and requires addition of methyl ethyl ketone peroxide for room temperature cure. Approximately 1% peroxide by weight will provide a life of 15-30 minutes at room temperature.

The preferred range of gel coat thickness for brushing applications is 10-15 mils. For spraying, conventional equipment for high viscosity materials may be used. With the two-pot system, additional cobalt and MEK must be added. Shelf life at room temperature is three months for accelerated types, and four months for non-accelerated. The coats are based on styrene monomer. Specific gravity is about 1.27; weight per gallon is about 10.5 pounds; viscosity at 77° F. is 9,000 cps.

Readers' Service Item 2

Bleeder Cloth-Parting Agent

Ventcloth, a woven glass fabric impregnated with a parting agent, combines the function of a parting agent, such as cellophane or polyvinyl alcohol film, with that of a bleeder cloth. The latter is required in vacuum-bag molding operations whenever a large laminate area is being cured and there is a chance that the vacuum will not draw out the air across the entire surface. The parting agent prevents the laminate from adhering to the bleeder cloth or vacuum bag.

Manufactured by Narmco Resins & Coatings Co., the cloth is most useful for phenolic and silicone laminates. As vacuum is drawn, air trapped under the bag surface escapes through the porous Ventcloth layer, which has been laid over the top of the laminate. According to Narmco, Ventcloth remains porous throughout the cure cycle, ensuring laminates that are virtually void- and air-free.

Because the fabric will leave an imprint at the contact surface, some finishing may be necessary to achieve a smooth laminate.

Readers' Service Item 3

Vinyl Acrylic Copolymer

A vinyl acrylic copolymer solution for laminating or formulating adhesives is now sold by the resin division of National Starch and Chemical Corp. The emulsion, designated Resyn 26-2404, is recommended for laminates of Mylar, cellophane, nylon, polyethylene, saran, paper, and foil. It also serves as a base for packaging, pressure-sensitive, and specialty adhesives, and as a vehicle for printing inks.

The emulsion may be thinned with many inexpensive solvents. Of these, it is incompatible with textile spirits, butanol, and ethanol. Films cast from Resyn 26-2404 are normally solvent sensitive and thermoplastic. By cross-linking with additives such as benzoyl peroxide (2% on solids) followed by a short bake (260° F.), the films develop good chemical resistance. Otherwise, the film is tacky.

The vinyl acrylic solution contains 40%

SAVE WHEN YOU BUY MACHINE AND MOLD AS A PACKAGE

Automolders are now in quantity production at reduced prices

One single responsibility, one source of top quality will give you both machine and mold at an over-all saving of time and money. Precision toolmakers treat each item with equal care to make both work together as a package to give you the best results.

STANDARD TOOL COMPANY

225 Hamilton Street, Leominster, Massachusetts

OMNI PRODUCTS CORPORATION—Export Distributors, New York, N.Y. 6

solids dissolved in 2:3 ethyl acetate: toluene. Typical properties are:

Viscosity, Brookefield LVF #3 spindle, 60 rpm., 72° F., cps.	500
Pounds/gallon, 72° F.	8.0
Flash point, °F.	39
Intrinsic viscosity, measured in acetone, 30° C.	0.6

Readers' Service Item 4

Seven Coating Resins

Union Carbide Plastics Co. has introduced seven products for coating formulations. Among them are a vinyl plastisol, two vinyl copolymers, a vinyl acrylic latex, a plastisol blending resin, and two epoxies.

Bakelite plastisol primer base BKSA-2750 was designed for the formulation of primers giving good adhesion between vinyl plastisol coatings and various metal substrates. Solvent is methyl ethyl ketone. Primers formulated from it are claimed to maintain excellent adhesion despite boiling water, salt spray, high humidity, and bending. Weighing 8.57 pounds per gallon, the solution has a specific gravity of 1.027.

QXPA plastisol blending resin, a pure PVC resin with an average particle size of 60 microns, can be blended with small particle dispersion resins to reduce the viscosity of the plastisol. It thereby decreases plasticizer requirements and makes possible coatings of high hardness.

A modified vinyl chloride copolymer for use in industrial maintenance finishes applied directly to metal, VXBC, has exhibited excellent adhesion, light stability, and tolerance for aromatic hydrocarbons, in preliminary tests. It is supplied as a powdery white solid with a specific viscosity (1% in MIBK solution) of 0.426. A vinyl chloride-vinylidene chloride resin is available as a 40% solution in a mixture of 90:10 toluene: methyl isobutyl ketone. Designated NXVC, its feature is that it may be sprayed at higher solids content and higher aromatic solvent content than conventional resins.

For films of excellent clarity, gloss, flexibility, and water-spot resistance, WCX-140 vinyl-acrylic latex may be employed. This internally plasticized material reportedly adds outstanding mechanical, thermal and electrolytic stability to films. High filming potential results in superior low temperature filming and high pigment binding ability.

Of the epoxy resins, ERRB-0100 is a novolak of high functionality for rigid, heat-resistant structures; EKRA-2131, with a low epoxy assay, results in more flexible products. Both show potential for fluidized bed coatings.

Readers' Service Item 5

Bookbinding Adhesive

Katex, a non-inflammable adhesive, can be used to bond vinyl book covers to paper with the same methods and equipment used to adhere paper covers. Adhesive Products Corp. claims this adhesive remains permanently flexible and waterproof, and is unaffected by most vinyl plasticizers.

The adhesive may be applied by brush, spray, or machine, and can be cleaned from equipment with soap and water before it dries.

Readers' Service Item 6

Heat-Stable Organo-Tin

Advance Solvents and Chemical division of Carlisle Chemicals Works, Inc., has made available Advastab T-360, an organo-tin sulfur containing heat and light stabilizer for chlorinated polymers. A white crystalline solid, the material is claimed to increase the heat distortion temperatures of rigid vinyls 8-12° F.

This stabilizer acts neither as a plasticizer nor lubricator. Further, it will not affect clarity in sheeting, moldings, and extrusions; or exhibit plateout on processing equipment or in molds.

Because T-360 will combine chemically with certain metals to form colored sulfides, no metallic fillers or stabilizers which discolor in the presence of sulfur should be used in vinyl compounds stabilized with T-360.

Readers' Service Item 7

STATTIC?

IT'S WRONG—NO MATTER HOW YOU SPELL IT!

The only good thing about static is that the Simco "Midget" now unconditionally guarantees to eliminate it! This safe, rugged, inexpensive static eliminator is designed to fit any machine, is effective on any material. Write today for complete facts. Anti-static cleaning devices and sheet separators, anti-static sprays and static measuring meters are also available.

America's Largest Manufacturer Specializing in Anti-Static Equipment

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920 Walnut Street, Lansdale, Pa.

for the reinforcement of
PLASTICS

FLIGHTEX GLASS CLOTH AND TAPES

- Highest standards of quality
- Uniformity of weight, weave and thickness
- Maximum strength of reinforcement

If you're out to win lower production costs, or higher quality of performance—if you want maximum efficiency in your glass cloth needs, FLIGHTEX may be able to assist. Our research laboratories and development facilities are ready to help find the exact fabrics to meet your particular needs.
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New Equipment

For more information check Readers' Service Card (p. 87)

Thoreson-McCosh loader-dryer combination.

Dryer-Preheater-Loader Unit

An automatic jet loader and dryer combination for granular plastic materials is being sold by Thoreson-McCosh, Inc. After the material is placed in a bin where it is dried and preheated, it is automatically conveyed up to the machine hopper.

Because material is conveyed by heated air from the dryer unit, use of compressed air, with attendant possibilities of contamination from shop air lines, is avoided. Non-chemical dehumidifying units are available.

The unit requires an approximate floor space of 32 by 35 by 52 inches. The nine cubic foot bin will handle 120 to 140 pounds of material an hour.

Readers' Service Item 21

Adhesive Applicator

A high-capacity applicator for gluing plain kraft box boards, materials surfaced with foil and polyethylene, and some waxed boards has been developed by United Shoe Machinery Corp. for its cord-like thermoplastic adhesives. Model BW Thermogrip Applicator will apply a maximum of 1,500 feet of ¼-inch seam or 1,000 feet of continuous ⅜-inch seam per minute. The hot melt adhesive may be applied in dots or other broken line patterns.

A rotating wheel applies adhesive to individual passing objects. The applying wheel is mounted in a heated housing from which the melt is dispensed. The wheel may be as wide as ½ inch. If a gravure pattern is desired, the size, shape and depth of the gravure cavities determine the amount of adhesive applied. With upstanding patterns, adhesive thickness is controlled by a metering bar adjustment.

Power is supplied from a base machine, at a minimum of 0.3 hp. Electric heater service requires 110 V., 60 cycles, 2,500 watts. Eleven heaters and three thermostats are supplied. All components are mounted on a base plate custom-designed to fit the user's parent machine.

Readers' Service Item 22

Heavy Duty Extruder Series

High screw speeds, maximum power input, and high extrusion pressures are the features of a line of extruders recently announced by Hartig Extruders. Developed to supplement the company's existing line, the series has been named Trapezoidal because of the shape of the base. The new design of the gear box, which houses a herringbone gear reducer of standard gears and bearings, is reported to permit increased thrust bearing capacity, internal lubrication, higher thermal ratings, and elimination of auxiliary cooling.

The cast iron thrust-bearing housing, designed for alternate bearing selections, has provisions for continuous lubrication. Double reduction gear reducer operates at 15.7:1, including hollow, low-speed shaft. Motor recommended is AC/DC electrical and magnetic slip coupling.

Standard machine includes: water-cooled feed screw, clamp with yoke and cam lift, prewiring to terminal in base, prepiping to manifolds, drilled breaker plate, lubricator for thrust bearing, auxiliary supply hopper, and barrel cooling tubes zoned equally with heaters. Motor ammeter-tachometer, air cooling, additional instrumentation, temperature safety controls, and melt thermocouple pressure gages are offered optionally.

The Trapezoidal series will be available in 2½-, 3½-, 4½-, and 6-inch screw sizes. Ratings for the smallest model are:

Reducer, 1,150 rpm. input, hp.	18.6
Thrust bearing, 100 rpm., 5,000 psi., average life-hrs.	42,500
Melt capacity, 0.92 density polyethylene, 100 rpm., lbs./hr.	150
Temperature, maximum, °F.	575
Pressure range, psi	3,000–5,000
With special cylinder and clamps, psi.	10,000
Screw speed, rpm.	100
Nominal hp., maximum	20

Readers' Service Item 23

Two-Part Resin Meter-Dispenser

The Auto-Rez-Mixer proportions, meters, mixes, and dispenses two-component, reactive resins such as epoxies, polyurethanes, and polyesters. Manufactured by C.P.M. Special Machinery Corp., this automatic dispenser has built-in safety features.

Three major processing phases are controlled by the Auto-Rez-Mixer. The Dispensi-Pump, an air-operated, hydraulically-controlled diaphragm pumping mechanism meters a precise volume of resin. The hydraulic mechanism is protected from component materials, which may be corrosive and abrasive, by a fluorocarbon diaphragm. The material flows into a gearmotor-drive rotary mixer, the Dispersi-Blendor, where it is blended fully. Freezing is prevented by an automatic purging system. The blended resin is dispensed through an air-operated diaphragm valve with positive shut-off. Sealed construction prevents contamination of the valve mechanism.

Optional features include de-aeration, heating, agitation, dispensing under vacuum, and interlocking synchronization with automated production lines. Electrical controls and pushbuttons are mounted in a remote JIC cabinet. Measuring 24 by 36 by 60 inches, the machine weighs 550 pounds.

Readers' Service Item 24

Valve for Viscous Media

Because the Gear-Vac valve, developed by Eco Engineering Co. for valving small flows of viscous media (up to 250,000), has only half the port size of the usual plug cock, it provides positive, linear, bubble-free flows which are measurable and reproducible.

No heating or pressurizing is required to include flow. Rather, the valve creates a vacuum, causing atmospheric pressure to collapse the viscous mass into the vacuum pocket. Metering accuracy should be within ± 2%. Flow is reduced by proportionately reducing the rpm. of the gear mechanism.

The unit features a standard 150 pound ASME three-inch flange on the suction side for connection to tank or reactor. Suction port is tapered to minimize resistance to passage of media. Threaded discharge port is ¾ inch. Depending upon the viscosity of the media, speeds of the gear can be adjusted from one to 900 rpm. Maximum pressure is 150 psi.; maximum temperature, 500° F.; maximum viscosity handled, 50,000 cps. Flow speed is up to one gpm. of 50,000 cps. in non-lubricating, dry, cohesive media; and to four gpm. in 220 cps. on lubricating media.

Gear-Vac valves are offered with handwheel for manual operation and motor-operated with pulley, sprocket wheel, or flexible shaft drive for remote or process-controlled operation on constant of cyclic flow.

Readers' Service Item 25

Plastics Development Pays Off for Hollow Products

If hollow products, parts or containers are important in your business you should know what blow molding and high density polyethylene from Grace have to offer. These dent-resistant, durable bottles by Owens-Illinois show a few of the benefits never before realized with other plastics and fabricating techniques.

High density polyethylene can be used to produce hollow objects such as these bottles that are featherweight yet remarkably rigid and strong, even in thin wall sections. Economies in production and raw materials naturally follow. In addition, these bottles are resistant to abrasion and virtually indestructible. They withstand refrigeration without cracking, autoclaving without distortion and exposure to most chemicals. Significantly, the Owens-Illinois no-drip bottles are comparable in cost with many of today's packages.

Blow molding also permits the use of Grex resins that result in superior strain-free characteristics, often difficult to achieve by other techniques.

Sound interesting in terms of the products you make? Then you'll also be pleased with the surprisingly low mold costs, too. For the full story on this versatile plastics development call in the high density polyethylene experts. Grace has the production facilities, technical service and experience to help put your product in the Grex profit parade. Everyone says we're easy to do business with.

Grex is the trademark for W. R. Grace & Co.'s Polyolefins.

W.R. GRACE & CO.
POLYMER CHEMICALS DIVISION CLIFTON, NEW JERSEY

Blow molding with Grex offers fabricating economies and new product possibilities.

Blow molding is today's fastest growing fabricating technique—and no plastics lend themselves to blow molding better than high density polyethylene. This holds true whether the application is as straightforward as these Owens-Illinois bottles, or as complex as toy cars large enough to hold a child. Here are a few reasons behind the boom in blow molding with high density polyethylene:

Savings in mold and equipment costs. Because of the low pressures involved in fabricating Grex by this technique, lightweight molds can be made of easily toolable materials. Thus mold costs are ⅛ to ⅓ less than for any other fabricating method. Furthermore, blow molding is a simplified technique, often adaptable to existing injection molding and extrusion equipment.

Economies in resin requirements and cycle times. The physical properties of Grex (rigidity, heat distortion resistance, abrasion resistance) permit blow molding of thin wall sections. As a result, less resin is used per molded piece. Cycle time—even for large parts—is also reduced. Cycles in blow molding are limited only by the time it takes to cool a part. Thinner walls made possible by the characteristics of high density polyethylene speed cooling and cut cycles.

Ease of molding. Complex shapes with serious undercuts, often difficult to blow mold with other plastics, rarely present problems when a Grex blow molding resin is specified. In fact, fabricators find this technique permits use of resins having superior physical properties without sacrificing moldability. Also inherent in blow molding is the fact that costly assembly operations are held to a minimum. The large toy car, for example, is blown in a single piece.

Find out more. If you have an application for blow molding with high density polyethylene—or think you have—count on Grace for help. Write now to:

Technical Service Department
W. R. Grace & Co., Clifton, N.J.

Transfer-Compression Machines

Three presses, with capacities of 150, 200, and 300 tons, comprise the line of automatic transfer and compression molding machines developed by Rodgers Hydraulic Inc. Also offered is an automatic preheater loader incorporating a Girdler dielectric heater. It feeds a controlled number of preforms to the transfer pot on any of the tonnage sizes offered, and can be adapted to existing semi-automatic or manual presses.

By means of easily accessible controls, operation of the transfer-compression presses may be changed from automatic to manual. Flexible hydraulic control of each operation is accomplished through adjustment of relief valves. Hold down or hold up is operated by positive acting air cylinders. Parts are ejected either from top or bottom. An oil cooler and water temperature controller is standard equipment.

Productions specifications of the three presses include:

	TCMA–150–2420–20	TCMA–200–3024–10	TCMA–300–3630–10
Press capacity, tons	150	200	300
Platen dimensions between rods, in.	24 x 20	30 x 24	36 x 30
Distance between platens, max., in.	38	38	42
Ram travel, in.	24	24	24
Pullback capacity, tons	14.5	19	23
Transfer capacity, tons	32	40	60
Transfer ram travel, in.	11	11	14
Transfer ram pullback capacity, tons	11	14	20
Ejector capacity, top and bottom, tons	11	12	12
Ejector stroke, top and bottom, in.	4	4	4
Motor size, 220V/3 phase/60 cycle, hp	20	20	30

Model PL–2¼–18–3 automatic preform heater-loader:

Dimensions, in., height to hopper top	90
Width, discharge hood retracted	80
Depth	34
Discharge hood, height above floor, in.	58–66
Discharge hood, stroke, in.	18
Preform diameter, max., in.	2¼
Preform thickness, max., in.	1¼
Number of preforms, at max. diameter	6
Preform feed rate, heater to transfer pot, sec.	1.5
Hopper capacity, approx., lbs.	150

Readers' Service Item 26

Miniature Glass Roving Cutter

A Miniature glass roving cutter, designed to be mounted on any resin spray equipment, has been introduced by Finn and Fram, Inc. Weighing only three pounds, two ounces, including pneumatic motor, it will cut more than three pounds of roving a minute. Cut fibers from ½ to four inches long are shot into the spray at an angle, at which point they are absorbed into the original spray direction.

Including motor, the cutter is 2½ inches wide, 3¼ inches high, and 4½ inches thick. Mounting extension extends two inches below the cutter, and hand operated valve projects beyond these dimensions.

Readers' Service Item 27

Mold Temperature Control Unit

A mold temperature control unit, arranged for single setting for temperatures to 240° F., is being manufactured by Autotherm, Inc. The unit has standard brass and copper piping. Elimination of a modulating valve and careful selection of seals reportedly eases maintenance. All wiring, located in the front half of the machine, is color coded.

The standard single unit is equipped with 9,000 watt heaters, but may be ordered with 4,500 watt heaters. Other features claimed are automatic shut-off on low water conditions, lack of pressure, automatic filling and air bleeds, pressure regulator on incoming water supply, and fast response to heating and cooling requirements.

Readers' Service Item 28

28-Ounce Injection Machines

Two 28-ounce, preplasticizing injection molding machines have been made available by Hydraulic Press Manufacturing Co. Both machines feature a three-way, rotary material control valve, adjustable stop nut, and high injection rates, and are recommended for molding linear polyethylene, polypropylene, acrylic, and the more common thermoplastics.

	Model 220-P-28	Model 350-P-28
Clamping force, tons	200	350
Plasticizing capacity, lbs./hr.	90	150
Mold mounting space, in.	15 x 26	20 x 34
Distance between platens, in.	25	34
With ejector box removed, in.	29	42
Stroke, in.	15	22

Readers' Service Item 29

Customers "feel" for quality in vinyl outerwear

That's why a fine "hand" is so important for vinyl fabrics. And, many producers are convinced that Plastolein Low-Temperature Plasticizers endow their products with the very best hand . . . the soft, suppleness that "makes friends" with the buyer right from the start.

These Plastolein Plasticizers keep him sold, too, by maintaining this fine hand at all temperatures, particularly throughout the chill range. And not for just a few months but *for many seasons* . . . even after prolonged exposure to summer heat.

Emery offers two outstanding low-temperature plasticizers: Plastolein 9058 DOZ, the ultimate in low temperature performance; and Plastolein 9078 L.T., its lower priced counterpart.

Write Department Q-4 for literature.

PLASTOLEIN® plasticizers

Emery

Organic Chemical Sales Department

Emery Industries, Inc., Carew Tower, Cincinnati 2, Ohio • Vopcolene Division, Los Angeles—Emery Industries (Canada) London, Ontario—Export Department, Cincinnati

Eight-Ton Punch Press

Alva Allen Industries' eight-ton model BT-8 will perform any standard punch press operations, such as blanking, forming, shearing, riveting, and crimping. Available in either bench (17 inches wide, 14 deep) or floor (18 inches wide, 23 deep) models, the press is equipped with a single pin, knife type clutch and can be easily changed from repeat, or continuous, to non-repeat, or single stroke, action. Other features are adjustable V-type ram gibs and adjustable ram for die setting.

Standard stroke is 1½ inches. However, stroke size may be ordered in ¼-inch graduations from ¼ to three inches. Standard press has die space of seven inches shut height and five inches throat. Spaces as large as 8½-inch shut height and ten-inch throat, which may be specified, permit use on larger parts.

Crankshaft diameter at main bearings, inches	1⅝
Main bearings, inches	2¾
Crankshaft diameter at connecting rod, inches	3
Height from bed to center od crankshaft, inches	18
Die bed area, inches	12 by 7
Opening in bed, inches	6 by 4
Die bed holes, center to center, inches	10¾
Ram length guide, inches	7⅛
Ram area, maximum, inches	4½ by 3½
Ram adjustment, inches	1½
Diameter of hole in ram for die shank, inches	1⅜
Knock out bar adjustment, inches	4½
Maximum degrees of inclination	30
Flywheel, inches, diameter	16
Face	3
Recommended speed, rpm	200
Motor, hp	½
Speed, rpm	1725

Readers' Service Item 30

Automatic Band Saw

Model 0-50, a band saw designed by W. F. Wells & Sons for high speed production cutting of plastics, wood, rubber, etc., will handle up to four- by five-foot sheets 20 inches thick with slices taken from the four-foot end. Maximum size of slice is 50 by 14 by ¼ to 14 inches.

A rolling table carries the sheet across the blade at a rate set by the operator. After it returns on rapid traverse, the sheet is unclamped, advanced, and reclamped. The cycle repeats automatically, at a maximum rate of four cyles per minute, until the final cut is made.

Modifications of the machine to cut four- by eight-foot sheets, any thickness, and to slice blocks through any dimensions, are also available.

Built with blade speeds and horsepower to order, the 0-50 is 73 inches high, 103 inches deep, and 110 inches wide. Blade size is 13 feet, 2 inches by 1 inch by 0.035 inch. Optional are JIC electricals and hydraulics, special paint, work light, and hydraulic filter.

Readers' Service Item 31

One shot, water blown flexible polyether foam requires 0.3 to 0.8% of UNION CARBIDE Surfactant L-520. No other surfactant gives the good stable rise, open cells and fine pores so necessary for high quality use such as cushioning.

One shot, fluorocarbon blown flexible polyether foam for extra soft pillows is almost impossible without UNION CARBIDE Surfactant L-520. Gives a good stable rise, too. Concentrations up to 1.5%.

One shot, rigid polyester foam, such as used for structural purposes, has virtually 100% closed cells with only 0.1 to 0.5% of XL-521.

Prepolymer, flexible polyether foam has 85% open cells, uniform structure when 10 or 50 cstk. UNION CARBIDE L-45 is used.

Prepolymer, semi-rigid polyether foam, such as required in crash-pad applications, is best made with about 1 to 2% of UNION CARBIDE LE-452 metered in at the foam machine.

Prepolymer, fluorocarbon blown rigid polyester foam, of the type used in refrigerator insulation, is 90% closed cells, has good rise and fine pores if made using between 0.1 and 0.5% of UNION CARBIDE XL-521 added to the prepolymer side. Closed cells hold fluorocarbon gas for low thermal conductivity.

LIKE TO KNOW MORE? Samples of these special silicone surfactants and Silicones Man technical aid from Dept. CN-4902, Silicones Division, Union Carbide Corporation, 30 East 42nd St., New York 17, N.Y. *(In Canada:* Union Carbide Canada Limited, Toronto 7.)

Unlocking the secrets of silicones

Rubber, Monomers, Resins, Oils and Emulsions

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Plastics Applications

For more information check Readers' Service Card (p. 87)

Jet King Blow Torch.

Phenolic Blow Torch Handle

The cool handles on Kidde Mfg. Co.'s pocket size blow torches are molded by Tech-Art Plastics Co. from general purpose phenolic. Phenolic was selected for its fine tactile properties, low heat conductivity, and low cost.

The Jet King butane torch finds industrial uses in soldering, brazing, paint removal, welding, and quick local heating in difficult locations.

Readers' Service Item 41

Reinforced Polyester Jo-Boat

Along the Louisiana-Mississippi gulf shore, Jo-Boat denotes a flat-bottomed, blunt-nosed workboat with fore and aft

Polymer Engineering's Jo-Boat.

access to the cabin. Oil field workers employ them to adjust valves and read gages which project above the surface of the Gulf of Mexico.

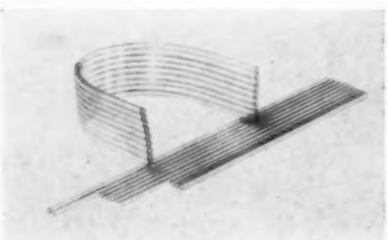
A 30-foot, lapstrake fiberglass-reinforced polyester Jo-Boat was recently put into service. Because of the dangers of fire at sea or in port, the molders, Polymer Engineering Corp., used fire retardant Hetron 32-A polyester resin manufactured by Durez Plastics Division, Hooker Chemical Corp.

Fiberglass-reinforced 32-A was used for the one-piece hull with unified skeg and strut, for the deck, cabin, cabin top, console, seats, vents, hatches, and longitudinal stringers. All parts were made by hand layup. The fiberglass reinforcement was light cloth, roving, and mat.

Readers' Service Item 42

Multiple Vinyl Tubing

Strip-a-Tube, which is produced by Jessall Plastics, division of Electric Storage Battery Co., consists of ten flexible vinyl tubes joined together in tape-like form. The individual tubes can be separated from the main body at any desired point. Available in 12 stock sizes from 1/32 to 1/4 inch I.D. in lengths of 100 feet, Strip-a-Tube is suggested for use in low pressure fluid distribution systems, multi-pressure measurement applications, and as harness in electronic consoles. It is stocked in both clear and color coded in translucent colors.



Jessall Strip-a-Tube.

Readers' Service Item 43

Unlined Plastic Screw Caps

A built-in gasket in Dover Molded Products Co.'s screw cap for cans or bottles eliminates the traditional liner. The gasket, molded of Marlex linear polyethylene in one piece with the cap, serves effectively as a sealing band. Called Un-A-Top, the cap is inert to most foods, drugs, and detergents, and eliminates the corrosion which may affect tin plate caps.

Manufacturers will find Un-A-Top eliminates problems of linear selection, warehousing, and stocking. Consumers will benefit, Dover points out, because the cap will eliminate leakage due to loss of liners.

Laboratory tests indicate that on steel cans, the cap will retain the water seal for 24 hours at 130° F. Torque required to effect a water-tight seal is one-quarter of that required for aluminum or steel caps. Exposure of the caps at high humidity and temperature with ketchup, autopolish, and tar remover produced no effects.

Cross-section of cap with molded-in gasket.

Readers' Service Item 44

Detachable-Base Cake Server

A styrene cake server tray with a detachable pedestal has been announced by Promotional Container Co. The pedestal is unlocked, for handling or storage ease, by a simple half turn twist. The 11-inch diameter tray was designed to capture a cut-glass effect. The pedestal, which brings the height of the server to 3¼ inches, is fluted.

Readers' Service Item 45

Germ-Free Polyethylene Toys

A line of fifteen baby toys marks the initial major application of a new bacteriostatic, bactericidal polyethylene. Blow-molded by Gerber Plastics Co. from Dow Chemical Co.'s Surfaseptic polyethylene, the toys are intended to provide added health protection for pre-schoolers.

According to laboratory tests with representative strains of harmful bacteria, Surfaseptic polyethylene fights and kills many strains of bacteria for the normal life of the toy. It is especially destructive to disease-producing staph. In addition, Surfaseptic polyethylene prevents development of off odors.

Any of Dow's polyethylene materials can be antiseptically formulated. Development of each self-sanitizing formulation will depend upon the customer's specifications. Materials can be supplied in granular or pellet form.

Readers' Service Item 46

Triple Module Sign

Anheuser-Busch, Inc. is promoting package store sales of its Busch-Bavarian beer six-packs with a three-section plastic sign. Each of the three separate modules, illustrating modern outdoor sports activities, employs two faces. The first is injection molded polystyrene and the second vacuum formed of translucent, white, impact-resistant polystyrene (Midlon HI) provided by Midwest Plastic Products Co.

The sports scenes are provided by transparencies inserted between the two faces. The faces are designed to diffuse light, illuminating each transparency to its best advantage. Changing transparencies according to the season results in what amounts to a new sign.

Vacuum formed and manufactured by Tel-A-Sign, Inc., the 12- by 54-inch units may be leaned against a wall as a counter display or suspended on a chain from the ceiling.

Readers' Service Item 47

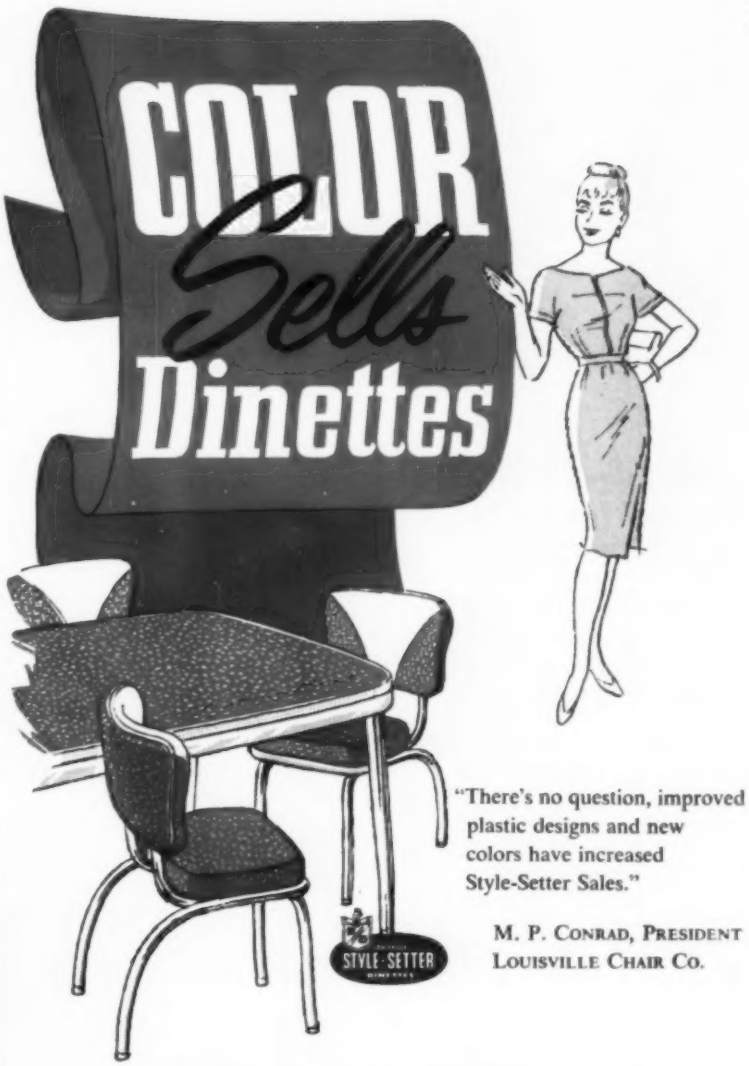
Electronic Component Case

A carrying case and storage cabinet for the protection of delicate electronic components is produced and sold by Highland Products. Designed to accommodate different sizes and shapes of components, the case is thermoformed from sheet made of W. R. Grace & Co.'s Grex high-density polyethylene.

The front of the case is a transparent sheet of cellulose acetate butyrate that slides up and down for access to the drawer at the base or shelves. The trays, which can be custom designed, help to cushion the parts against shock, and prevent them from bumping during transit.

Polyethylene carrying case-storage cabinet.

Readers' Service Item 48



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LOUISVILLE CHAIR CO.

The Kentucky Color Technical Service Lab is constantly developing new and better colors for plastics . . . Take advantage of this service by writing for full information.

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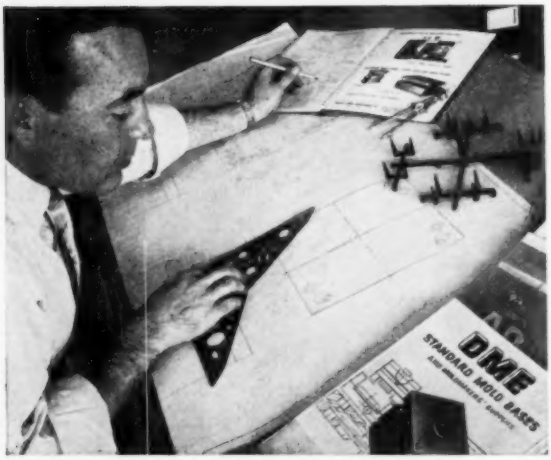
MOLD DESIGNERS



SAVE MORE ON MOLD COSTS With Over 6,000 D-M-E Standard Mold Bases to Choose From

Whether it's a one-cavity "test" mold or a 60-cavity high production run, chances are D-M-E has the right size Standard Mold Base to fit the job and the molding machine.

D-M-E's 32 standard sizes, up to 23¾" x 35½", with 100 standard cavity plate combinations for each size, give you the largest selection of carbon or alloy steel standards available from any single source.

Save on Design and Moldmaking Time, Replacement Parts and Delivery

Design time is reduced by using D-M-E's full-scale Master Layouts and Catalog of specifications and prices. Moldmaking time is reduced because all D-M-E plates are precision ground flat-and-square, ready for cavity layout and machining. Exclusive interchangeability gives you the added saving of immediate replacement of any component part. And D-M-E's seven branch offices and warehouses are always fully stocked with Standard Mold Bases and components to meet your delivery requirements.

Cut Costs on Your Next Program

Start saving on your next moldmaking program, no matter how large or small. Take advantage of D-M-E Quality, Service and Economy.

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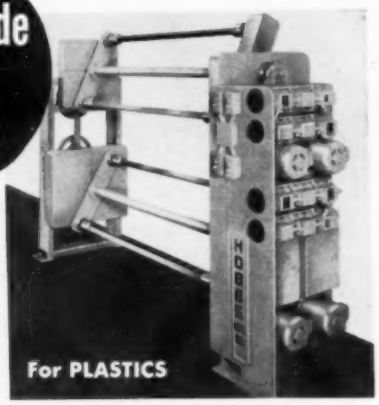
- D-M-E CORP., CLEVELAND: 502 Brookpark Rd.—DAYTON: 558 Leo St.
- D-M-E of CANADA, Inc., TORONTO, ONT.: 156 Norseman Ave.

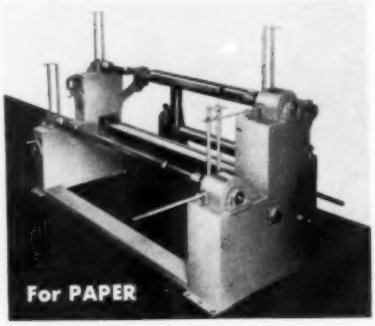
HOBBS

Web Winding Machines

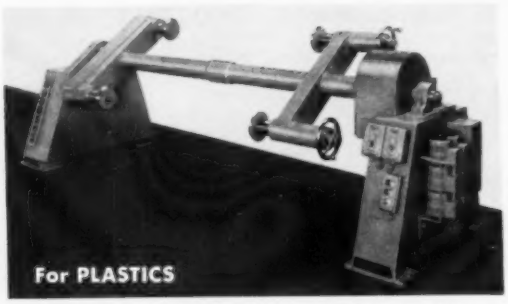
Tailor-Made for the Job



Double Turret Extruder Winding Machine specially designed for prominent plastics manufacturer.



Staggered 2-Shaft Winding Machine specially designed for nationally known tag and label manufacturer.



Shaftless Adjustable Winding Machine specially designed for leading chemical manufacturer.

What are your web winding requirements? Tell us in detail. Hobbs can fit the design to the job to give you

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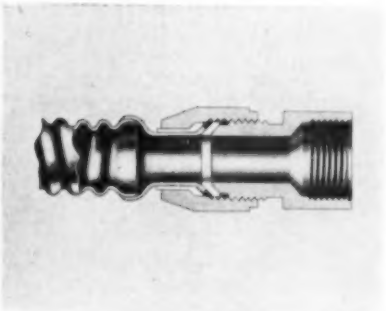
149-9

Plastic-Insulated Connector

A flexible copper connector incorporating built-in plastic insulating separators has been developed by Central D Manufacturing Co, with the assistance of Peerless Plastics Co., custom molders. Polyethylene seat and sleeve separators, injection molded from high density Insulon polyethylene, eliminates electrolytic corrosion between the steel union adapter and the copper connector at the nut and along the flare.

Useful for liquid and gas pipe lines, Waterflex is designed to withstand a hydrostatic pressure of over 2,000 psi.



Cross-section of Waterflex connector.

Readers' Service Item 49

RP Roof Ventilators

Six roof ventilators, claimed to be the largest ever made from plastic, have been completed by Beetle Plastics division, Crompton & Knowles Corp. Produced of Bonate M-92, Beetle Plastics' fiberglass-polyester laminate, each 7½-feet high ventilator has a 36-inch propeller capable of delivering 29,000 cubic feet per minute. The corrosion resistant housing, built to fit the pitch of the roof, holds a five hp. motor; plastic, air-operated dampers; and plastic four-blade propeller and shroud.

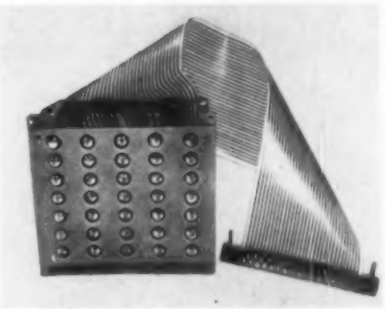
The ventilators have been installed at a large New Jersey chemical plant, whose manufacturing process emits sulfuric and muriatic acid fumes.

Readers' Service Item 50

Flexible Printed Circuit

Laminating thin copper conductors between insulating layers of flexible plastic sheeting produces a flexible printed circuit. Flexprint wiring, manufactured by Sanders Associates, Inc., simplifies design of electronic and electrical systems because it can be routed through crowded layouts. Thus, the assembly does not have to be designed around the circuit.

Sanders recommends Flexprint for complex circuits such as computers, telephone and telegraph switchboards, relays, and industrial controls. Krene vinyl sheeting, a product of Union Carbide Plastics Co., is used for most Flexprint circuits.



Vinyl-insulated Flexprint circuit.

Readers' Service Item 51

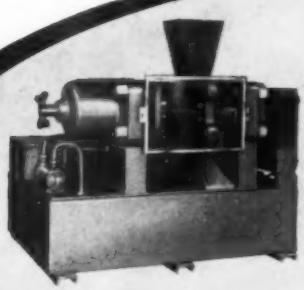
Plastic Cabinets

Tech-Art Plastic Co. has placed on the market a line of thermosetting and thermoplastic cabinets suitable for radio sets, instruments, or electronic devices. To avoid identification with a particular product, the eight cabinets are conservatively designed. Brand identification may be achieved by name plates, hot stamp imprinting, decalcomania transfers, and other applied decorations.

All cabinets are available in self-extinguishing materials. Sizes range from 6¾ to 13$^{3}/_{16}$ inches in length, 5¼ to 7⅝ inches in width, and 3½ to 6$^{5}/_{16}$ in height.

Readers' Service Item 52

..... In Logan You DO Get Improved Design



HYDRAULIC PREFORMERS

They may be used for handling the entire range of materials from G.P. phenolics to higher impacts that are rag filled. Capacity range: 30 to 125 tons.

HYDRAULIC PRESSES

For semi-automatic and automatic compression and transfer molding of plastics and rubber. Custom designed presses for special applications. Capacity: 10 to 400 tons.

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New Literature

For more information check Readers' Service Card (p. 87)

"Tom Swiftly and his Timed Machines." Lester-Phoenix, Inc. 4 pages. A fable suggests analysis of the economics of injection molding productivity.

Readers' Service Item 61

"General Guide to M & T Products, Processes." Metal & Thermit Corp. 2 pages. Among M&T products are such chemicals for plastics as flame retarders, barium-cadmium and organotin stabilizers, catalysts, and organic coatings. These products, as well as equipment for welding, are listed in the brochure.

Readers' Service Item 62

"Hydro-Chemie Manufacturing Program." Formvac Information 24. Conapac Corp. 4 pages. The leaflet illustrates and describes five vacuum forming machines. Automatic and semi-automatic equipment to produce sheets, cylindrical items, and filled containers; and two short-run, economy models, are included.

Readers' Service Item 63

"Eastman Plasticizers." Catalog L-104. Eastman Chemical Products, Inc. 32 pages. This comprehensive catalog includes not only physical and chemical properties and specification data of all Eastman plasticizers, but a guide to plasticizer selection, resin compatibility tables, and charts indicating performance characteristics of plasticizers in different plastic and plastisol formulations. Figures demonstrate effects of temperature on vapor pressure, viscosity, density, and weight per gallon. Directions for preparing films for testing and performing tests are provided.

Readers' Service Item 64

"Automatic High Production Blow-Molding Machines." Auto-Blow Corp. 4 pages. Discussion of the operation, controls, and features of Auto-Blow machines comprises the bulk of the bulletin. Specifications of models 60-9, 150-7, and 450 D 15 are tabulated.

Readers' Service Item 65

"DEL Synthetic Rubber Compound and Protective Coatings." David E. Long Corp. 16 pages. A Del paste compound for use in expansion joints and for caulking, glazing, and sealing; and vinyl, epoxy, acrylic, alkyd, and other industrial plastic coatings are defined. Features and uses of each are outlined.

Readers' Service Item 66

"GRC Injection Molded Tiny Delrin Parts." Gries Reproducer Corp. 8 pages. Featuring a reprint of a paper, "Designing with Delrin," presented to the Rubber and Plastics Division of ASME, the pamphlet also describes some GRC molded parts and presents approximate specifications.

Readers' Service Item 67

"Meet the Nations' Top Vacuum Former." Chanal Plastics Corp. 8 pages. This illustrated brochure on the vacuum forming of thermoplastic sheeting presents the procedure by which an article is designed, molded, and assembled.

Readers' Service Item 68

"IMS Heating Cylinder Handbook." Injection Molders Supply Co. 32 pages. Directions for installing, starting up, purging, shutting-down, and maintaining heating cylinders are provided. Hints on thermocouple location and heater band arrangement, as well as a list of standard stock nozzles, thermocouples, and heater bands, are included.

Readers' Service Item 69

"The Pak-O-Vac Automatic Blister Attachment." Product Packaging Engineering. 1 page. When attached to the company's vacuum former, the attachment transforms it into an automatic blister-forming unit.

Readers' Service Item 70

"Dimethylformamide as a Polyvinyl Chloride Solvent." Industrial and Biochemicals Department, E. I. du Pont de Nemours & Co. 14 pages. DMF's solvent effect allows use of high resin content solutions giving thicker coatings in roller or spray applications, while its medium range boiling point suggests use in baked-on coatings. It is most effective with higher molecular weight materials.

Readers' Service Item 71

"Bijur Cyclic Y Lubricator." No. 57C. Bijur Lubricating Corp. 2 pages. The Cyclic Y Lubricator, which will operate on any hydraulic line pressure from 1,000-3,000 psi. is described and illustrated.

Readers' Service Item 72

"Eastman Cellulose Acetate." No. E-105. Eastman Chemical Products, Inc. 35 pages. The various types of cellulose acetate for protective coating formulations are discussed in terms of their general properties, solubility, and compatibility. The brochure recommends types of resins for specific application requirements.

Readers' Service Item 73

"Moplen Breakthrough in Polyolefins." Chemore Corp. 12 pages. Products of Moplen, Montecatini's isotactic polypropylene, are illustrated. This non-technical bulletin summarizes Moplen's processing characteristics.

Readers' Service Item 74

"Building Better Colors." Plastic Molders Supply Co., Inc. 27 pages. The bulletin analyzes coloring problems with thermoplastics. It lists nomenclature and prices of PMS pigments, mold releases, dispersions, and equipment, such as blenders, breaker plates, sprue pullers, and gate cutters.

Readers' Service Item 75

"IMS Heater Band Stock List." Injection Molders Supply Co. 1 page. The sheet provides prices, watts, voltages, and sizes of stock nozzle bands from 1 inch I. D. by 1 inch wide to 8 inches I. D. by 1½ inches wide.

Readers' Service Item 76

"Facilities Report." Swedlow Inc. 28 pages. After describing research, development and production methods, and equipment, this brochure presents reports on glazing materials, reinforced plastics, high temperature parts and laminates, metallized heat reflective laminates, and high temperature welded honeycomb core.

Readers' Service Item 77

"Technical Bulletins." Rubber Latex Co. of America. 8 pages. Properties, uses, and applications of eight neoprene — or reclaim rubber-base adhesives are featured. Both pressure sensitive and wet bonding adhesives for bonding plastics to other materials or to themselves are included.

Readers' Service Item 78

RONA™

SYNTHETIC

PEARL PIGMENTS

FOR COMPOUNDING INTO

- POLYETHYLENE
- POLYSTYRENE
- VINYL
- ACETATE
- NITRATE
- ACRYLICS
- CASEIN
- POLYESTERS
- PHENOLICS (CAST)
- ACRYLICS (CAST)
- POLYPROPYLENE and other resins

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Rona Pearl Pigments are heat and light stable, non-reactive non-corrosive, and impart high pearly luster, exceptional depth and brilliance at very low cost.

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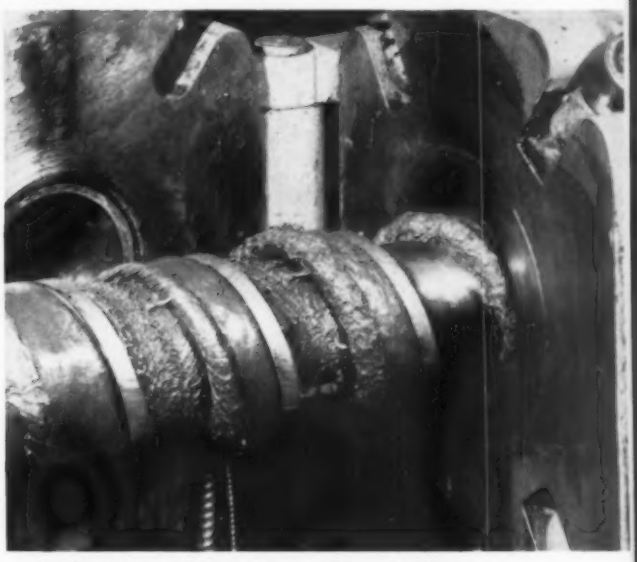
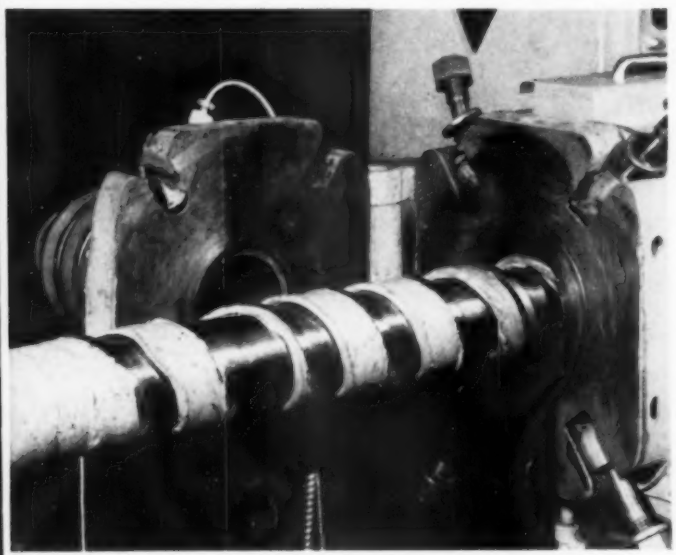
now...clean your extrusion or injection machine in hours...not days...with A-C Cleaning Compound

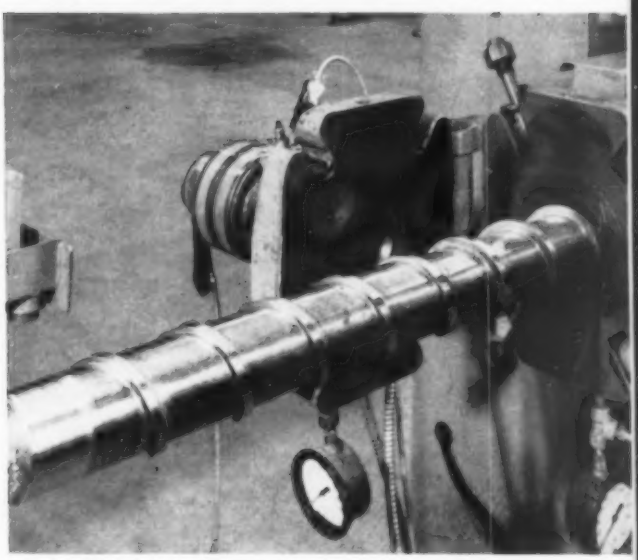
1. Empty hopper and load with A-C Cleaning Compound.



2. Operate machine to purge old material.



3. Note how A-C Cleaning Compound strips off easily.



4. In hours—not days—a clean machine ready for the next run!

If you've been losing days and dollars in making change-overs, here's good news! Allied's Semet-Solvay Petrochemical Division has now developed a cleaning compound that will completely remove any thermoplastic material—and do it in a fraction of the time normally required. The simple procedure is pictured above.

One extruder tells us that he saves $5,000 by using A-C® Cleaning Compound—cleans a machine in 1½ hours without tearing it down.

You'll find A-C Cleaning Compound speeds changing material or colors, and eliminates cylinder contamination. It purges without scratching and strips cleanly and easily from extrusion screws without mess.

For a free bulletin telling how this new cleaning compound can save *you* time and money, just write us at the address below.

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Article Abstracts

Materials

"The Copolymers of Vinyl Chloride," P. L. Sbrolli and L. Lucchetti, MATERIE PLASTICHE, 24, 9, 798; 25, 1, 21; 25, 2, 95; 25, 4, 302 (Sept. 1958; Jan., Feb. and April 1959).

On the basis of studies of the literature as well as their own work, the authors present in a series of articles what is presently known of the copolymerization and copolymers of vinyl chloride. The introductory article deals with the reactions of vinyl chloride copolymerization and the mechanisms involved. Part II discusses the effects of copolymerization on the properties of products obtained, and compares them with those of pure PVC. In part III are examined such factors determining the use of copolymers as economics, nature and percentage of co-monomer in the copolymer, average molecular weight, homogeneity, applications, and special properties of the copolymers. Part IV discusses copolymers with vinyl esters, and deals with methods of production, properties, types in general use, and applications. Finally, the authors report on tripolymers, modified copolymers, and copolymers with higher vinyl esters. (In Italian.)

"Control of Quality, Manufacture and Permeability of Plastics Pipes," E. Numann and O. Umminger, *Kunststoffe*, 49, 3, 113 (March 1959).

In this second paper, reference is had to results reported in the first report. Work is described which was carried out at different temperatures on pipe made of rigid and flexible polyethyelene and rigid PVC to determine the extent to which findings can be utilized in establishing specifications for testing water pipe guaranteed for 50 years at 20° C. Conditions of tests are discussed in detail. (In German.)

"Polypropylene," G. Crespi and F. Ranalli, TRANS. PLASTICS INST., 27, 68, 55 (April 1959).

The properties of polypropylene, particularly the mechanical properties in relation to isotactic index and average molecular weight, are treated in detail. The various processing methods for the material (especially the variables influencing injection molding and extrusion) are dealt with, and applications are listed.

"Oriented Thermoplastic Sheet and Film," C. P. Fortner, MATERIALS DESIGN ENG., 50, 7, 94 (Dec. 1959).

Effects of orientation, and how to design with oriented sheet and film.

"Long Term Behavior of Polyethylene and PVC Pipe," H. Niklas and K. Eifflaender, *Kunststoffe*, 49, 3, 109 (March 1959).

This is the first of three reports on tests carried out by the Plastics Branch of the German Standards Committee in collaboration with six leading German firms aimed at drafting for flexible and rigid polyethylene and rigid PVC water pipe with a service of 50 years. After explaining the difficulty of mathematically predicting the behavior of this type of products when undergoing multi-axial stresses, and the inadequacy of the usual tests, the authors describe the principles, methods and means used in long-term tests carried out at constant temperature and constant internal pressure. Curves found for flexible and rigid polyethylene pipe indicated that the decrease in mechanical strength at first is gradual, but then drops quickly, corresponding to a change in the rupture mechanism from deformation rupture to brittleness rupture. Some of the curves for rigid PVC followed a straight-line course, others eventually bent downward more or less steeply. The change here is ascribed to prolonged contact with water or other fluid, not to the rupture mechanism. (In German.)

"Extrapolation, Safety Factors and Allowable Stress for Polyethylene and PVC Pipe," K. Richard and R. Ewald, *Kunststoffe*, 49, 3, 116 (March 1959).

In the third paper of the series, the graphic extrapolation of long-term tensile test curves is explained by the example of Ziegler polyethylene, and the Larson-Muller correlative method is discussed. It is shown how permissible pressure (710 psi. at 20° C.) for Ziegler polyethylene pipe can be calculated from the tensile-time/elongation limit curves and a suitable safety factor. But before permissible stresses for flexible polyethylene and rigid PVC pipe can be determined with a proper degree of accuracy, more results of long-term tests will have to be available. (In German.)

"The Chlorofluorinated Polymers Kel-F and Voltalef," A. Flamant, *Ind. Plastiques Mod.*, 11, 3, 26; 11, 5, 45 (March & May 1959).

A company has been formed in France by four leading chemical concerns to produce Kel-F (to be known as Voltalef) and teflon (to be called Soreflon). The present paper reviews the production of the different types of Kel-F, their properties (comparing them with Teflon), processing, and applications. (In French.)

In the reference system used, the first number following the magazine name is the volume number, the second is the issue number (if any), and the third is the first page on which the abstracted article appears in that magazine.

Request for copies, reprints, or further information on any article abstracted in this department should be addressed to the publisher of the magazine where the article appeared. A complete listing of the publishers and addresses of these magazines is printed here quarterly.

The next complete listing will appear in June. The last listing appeared in the February issue.

"Use of Reground Glass-Filled Polystyrene," G. R. Rugger, SPE J., 15, 12, 1053 (Dec. 1959).

Results of tests on combinations of reground and virgin materials.

"The Synthesis and Polymerization of Various Methylstyrenes and the Correlation of their Thermal Softening Points with Chemical Structure," B. J. Hennessy, TRANS. PLASTICS INST., 27, 70, 126 (Aug. 1959).

In connection with work to develop styrene-type polymers with increased heat resistance, the author investigated two new methods of synthesis for methylstyrenes, both involving Friedel-Crafts reactions. Evaluation of thermal softening points and correlation with chemical structure indicated that methyl substituents in the ortho position confer a high degree of heat stability. It is suggested that polymethylstyrenes may replace polystyrene satisfactorily in most applications.

"Prediction of Impact Resistance from Tensile Data," R. M. Evans, H. R. Nara, and E. G. Bobalek, SPE J., 16, 1, 76 (Jan. 1960).

A report on significant advances in tensile strain rates.

"Bursting Strength of Thin Sheet and Film," J. Schreiber, PLASTE U. KAUTSCHUK, 6, 2, 71 (Feb. 1959).

The author critically discusses three formulas for converting measured bursting values for thin sheet and film into actual bursting strength values. He comes to the conclusion that the usual calculations of tear strength and, consequently, also the tensile values indicated in the literature, do not correspond with the facts. (In German.)

"Strength of Reinforced Laminates," B. G. Heebink and Gordon Stevens, SPE J., 16, 1, 39 (Jan. 1960).

Test results are given to show the effect of storage conditions on glass fabric.

"Premixed Polyester Moulding Compounds in Europe," N. A. Cutler, BRIT. PLASTICS, 32, 8, 370 (Aug. 1959).

To study the development of premixes in Europe, the author visited a total of 46 organizations in France, Holland, Germany, and Italy. His report is in two parts dealing respectively with formulation and processing; and molding, testing, and commercial development.

"Analysis of Commercial Formaldhyde by Combined Measurement of Dielectric Constant and Density," F. Oehme, KUNSTSTOFFE, 5, 226 (May 1959).

A method is described in which the values for dielectric constant and density are plotted in a triangular system of coordinates, whereby the required formaldehyde or methanol content is immediately obtainable. (In German.)

THE
COLOR APPEAL
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The consumer impact achieved from finished products of extruded or molded polyethylene is greatly determined by faithful duplication of the original color sample from the designer. For rich, vivid colors or soft, warm colors, matched exactly to the color you desire, STAN-TONE PE Polyethylene Color Concentrates are your answer.

Now available in pellet form, STAN-TONE PE Colors minimize dusting and combine exceptional heat and light stability with high resistance to migration, crocking, leaching and bleed. Excellent in high-density polyethylene applications. STAN-TONE PE Colors are ideal for use in polyethylene containers, film, filament, pipe and wire and cable.

Other STAN-TONE Colors for plastic and rubber:

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▶*STAN-TONE PEC Polyester paste* ▶*STAN-TONE Paste*
▶*STAN-TONE GPE 50% Pigment concentrate*

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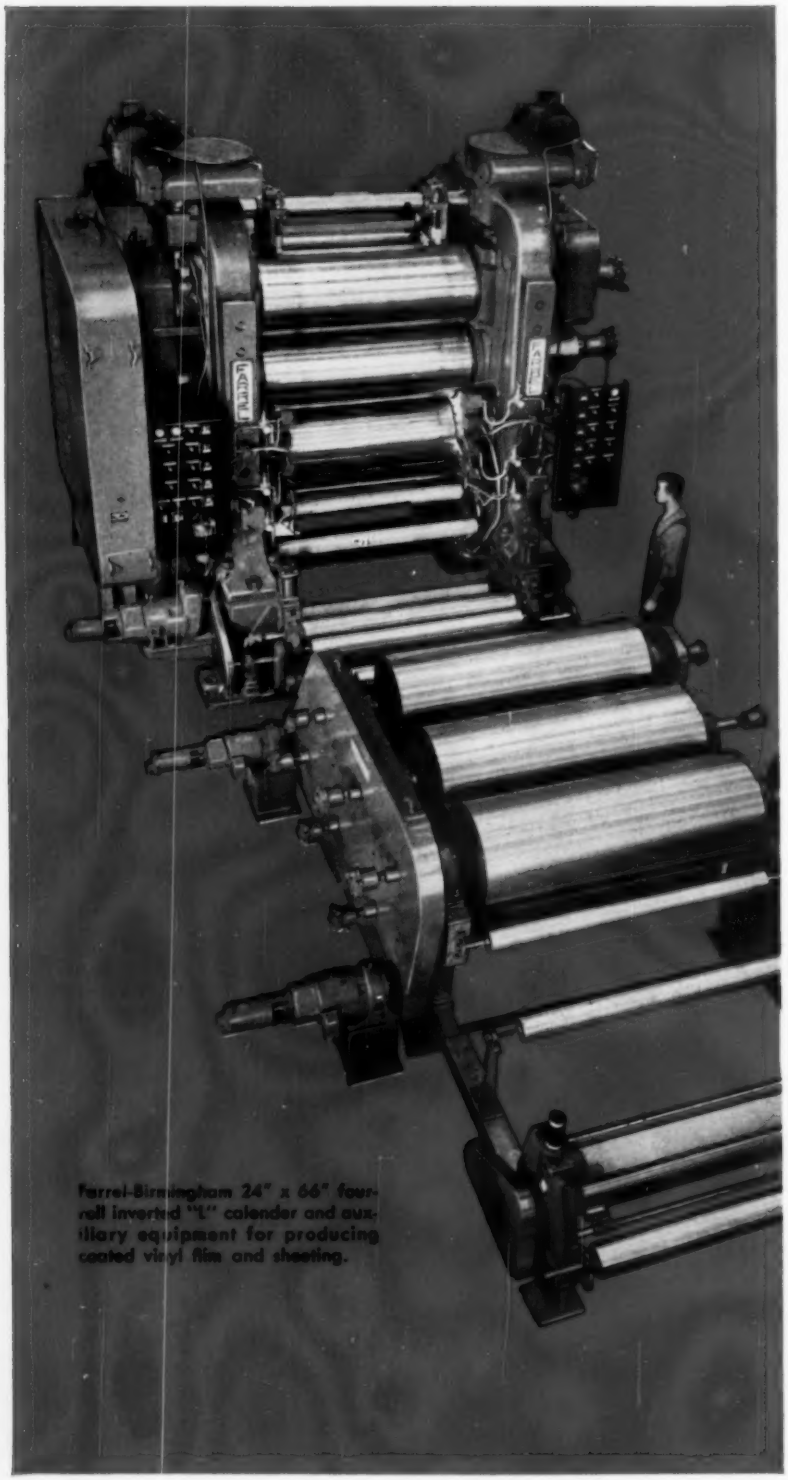
DUAL-PURPOSE CALENDER TRAIN

maintains accuracy in producing and coating vinyl film and sheet



Farrel-Birmingham 24" x 66" four-roll inverted "L" calender and auxiliary equipment for producing coated vinyl film and sheeting.

The calender train shown here was designed by Farrel-Birmingham for producing vinyl film and sheeting, and then coating them with butyl rubber at speeds up to 80 yards per minute. The calender has a motorized crossed-axes device which accurately compensates for roll deflection under the varying conditions of calendering film, sheet and finished product, assuring extremely close gauge control for the final pass for each. A heating and cooling system is furnished to provide the necessary heating range for vinyl material and also the moderate temperatures required for butyl.

Vinyl film is produced in the first operation, then stored in rolls which are later unwound for the coating process. A freshly calendered butyl sheet is laminated with the vinyl film or sheet, after which the combination is cooled, wound up, and subsequently slit into tape-width strips for delivery. The finished product is used for covering underground pipe lines.

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"The Specific Heat of High Polymers," R. W. Warfield, M. C. Petree, and P. Donovan, SPE J., 15, 12, 1055 (Dec. 1959).

Specific heat values are given for some thermoplastic and thermoset materials.

"A New Extender for Adhesives Based on Rice Husks," D. Narayanamurti and R. C. Kohli, KUNSTSTOFFE, 49, 6, 269 (June 1959).

Investigations in India on the use of ground rice husks as filler in phenolic resin adhesives for wood led to alkali-extraction of the husks. From the resulting residue mixed with 12-15% phenol resin, hard board could be produced. (In German.)

"Extreme Temperature Organics," Wilfred Lynch, PLASTICS WORLD, 17, 12, 26 (Dec. 1959).

A brief report on some fluorocarbons and silicones.

"Stretching and Shrinking of PVC Film," H. Haldenwanger, KUNSTSTOFFE, 49, 6, 270 (June 1959).

During production and transformation, thermoplastic film undergoes a certain amount of stretching which, depending on grade of material, and time and temperature factors, may later result in varying degrees of shrinkage. Measurements of recovery due to the effect of time and temperature give an insight into the regularity with which these phenomena occur, and indicate which influences lead to later undesirable dimensional changes. (In German.)

"The Dynamic Mechanical Properties of Epoxy Resins," D. H. Kaelble, SPE J., 15, 12, 1071 (Dec. 1959).

Direct correlations are given between softening temperatures and regions of major dynamic mechanical dispersion.

"Terylene Polyester Fiber as a Resin Reinforcement," W. Glen, BRIT. PLASTICS, 32, 6, 273 (June 1959).

Presented to show the improvements obtainable by the use of terylene polyester fiber electrical and other laminates in chemical plants, this article deals with the forms in which the fiber is available, its chemical, electrical, weathering and other properties.

"The Influence of Chemical Structure upon the Physical Properties of Polymers of the Lower Ring-Alkylated Styrenes," T. E. Davies, BRIT. PLASTICS, 32, 6, 283 (June 1959).

From a survey of the data on the relationship between the physical properties and chemical nature of the alkyl styrene polymers, it is concluded that the ortho-substituted alkyl styrenes, and possibly also the highly-branched types, are likely to be of most interest in the future. In connection with this branching, it is suggested that the feasibility of a lower reactivity due to stereo hindrance effects may be important in certain cases.

Equipment

"How to Specify Plastics Parts," R. L. Miller, MATERIALS DESIGN ENG., 51, 1, 94 (Jan. 1960).

A practical guide to help in obtaining highest quality at minimum cost.

"A Study of the Accelerated Aging of Vinyl Plastic Compounds in a Modified Testing Oven," Markus Royen, ASTM BULL., p. 43, No. 243 (Jan. 1960).

Present standard methods are not reproducible, and such results can be obtained with a suggested new oven design.

"Use of Restrictor Plate for High Gloss PVC Injection Moldings," H. A. Williams, BRIT. PLASTICS, 32, 8, 378 (Aug. 1959).

By the technique described, moldings of high gloss are obtainable with the use of lower cylinder temperatures, and neither the gate of the mold nor the nozzle of the cylinder need be modified.

"Automatic Ejection from the Stripper Plate in Injection Molds," H. Gastrow, KUNSTSTOFFE, 49, 6, 300 (June 1959).

A construction is described which insures complete automatic ejection of boxes with offset edge. Spring catches are not used. (In German.)

"Regulated Direct Current Drive in Calenders for Plastics," F. Kummel, KUNSTSTOFF-RUNDSCHAU, 6, 2, 52 (Feb. 1959).

The technique of direct current motors in calenders for plastics, and the advantages offered by suitable adjustment to processing requirements, are explained by numerous examples. (In German.)

"Single Cavity Molds for Screw Caps, with Antechamber and Internal Gates," H. Gastrow, KUNSTSTOFFE, 49, 5, 247 (May 1959).

The mold described, which is intended for small automatic injection machines and limited quantities, permits automatic unscrewing of the moldings without the need for a special motor despite the antechamber and internal injection. (In German.)

Applications

"Epoxy Resin Dies for Deep-drawing Sheet Metal," J. Hugo and M. Vanek, PLASTE U. KAUTSCHUK, 6, 3, 109 (March 1959).

To determine the usefulness of epoxy resins for making deep-draw dies for sheet metal, static and dynamic abrasion resistance and other mechanical properties were tested on compounds of two Czechoslovakian epoxy resins with various fillers, including quartz sand, aluminum powder, aluminum hydrate, limestone, graphite, and iron and steel powders. Mention is made of an epoxy die which in a preliminary test showed very little abrasion wear after having been used to make 200 moldings from steel sheet 0.8 mm. thick. (In German.)

"Epoxide Resins as Packing Material for Insulated Electrodes in High Pressure Plant," M. Richard and M. Krotzsch, PLASTE U. KAUTSCHUK, 6, 2, 63 (Feb. 1959).

A high-pressure plunger, containing seven insulated electrodes, and having a diameter of 26 mm., is described. For insulation and packing of the electrodes, a mixture of epoxide casting resin and quartz sand was used. In a test, the plunger withstood a pressure of 7,500-9,600 kg./-cm. uninterruptedly for 68 hours at temperature between 10° and 95° C. (In German.)

"Plastics for Sliding Bearings," R. V. Goring and H. Strenge, PLASTE U. KAUTSCHUK, 6, 3, 124 (March 1959).

This article is divided into a theoretical and a practical part. In the second part, Strenge describes experiences with phenolic bearings, and considers requirements as to shaft material and lubricants. (In German.)

"Acrylics in Advertising," F. Esser, KUNSTSTOFFE, 49, 5, 248 (May 1959).

Construction and design, methods of manufacturing displays and signs, and printing and coloring are dealt with. Results of extensive aging tests under normal and extreme climatic conditions are reported. (In German.)

"Epoxide Resins Improve High Tension Apparatus," A. Catella, IND. PLASTIQUES MOD., 11, 9, 67 (Sept.-Oct. 1959).

Glass-epoxide laminates, casting materials of epoxide resin and powdered quartz, and epoxy resin-based adhesives help in various ways to solve the problems posed by developments in high-tension apparatus. The author discusses the uses of epoxies, chiefly in circuit breakers, lightening arresters, and current transformers. (In French.)

"New Applications of Plasticized and Unplasticized Vestolit PVC Granules," G. Wick and H. Konig, KUNSTSTOFFE, 49, 7, 307 (July 1959).

The properties of various types of Vestolit produced at Huls, both plasticized and unplasticized, are discussed in connection with specific uses. New applications, chiefly industrial, are described. (In German.)

"Plastics for Durable Industrial Packaging," F. Reinke, KUNSTSTOFFE, 49, 5, 217 (May 1959).

Durable and reusable containers, racks, trays, inserts, and the like, are made of polyester glass resins and now to an increasing extent of thermoplastics for packaging industrial materials, semi-manufactures, and finished products for shipment and storing. The author discusses various

(Continued on page 84)

Patent Digest

Materials

Process of Extruding Vinylidene Chloride Resin Plasticized with an Ethylene Glycol Dibenzoate. No. 2,875,168. W. M. Smith, Jr., Cuyahoga Falls, and C. E. Best, Franklin Township, Summit County, O. (to Firestone Tire & Rubber Co., Akron, O.).

Copolymer Polyhydric Phenol Resin. No. 2,875,178. F. P. Greenspan, Buffalo, and R. E. Light, Jr., Kenmore, N. Y. (to Food Machinery and Chemical Corp., San Jose, Calif.).

Labeled Plastic Containers. No. 2,873,877. L. H. Morin, Bronx, N. Y.

Mammary Prostheses. No. 2,875,449. E. A. Morris, Blackpool, England.

Surface Ornamentation of Flexible Sheet Materials and Method of Making Tools for Producing Such Ornamentation. No. 2,875,543. A. D. Sylvester and A. H. Scheiding, Rowayton, Conn. (to L. E. Carpenter & Co., Inc., Wharton, N. J.).

Preparation of Graft Copolymers. No. 2,873,240. M. I. Miller, New York, N. Y. (to American Cyanamid Co., New York, N. Y.).

Polymerization Process for Olefin Oxides. No. 2,873,258. A. B. Borkovec, Lake Jackson, Tex. (to Dow Chemical Co., Midland, Mich.).

Urea-Formaldehyde Gap-Filling Adhesive. No. 2,873,260. J. F. Corwin, Pittsburgh, Pa. (to Koppers Co., Inc.).

Novel Alkyd Resins Prepared from Indandicarboxylic Acids and the Process of Preparing the Same. No. 2,873,262. J. C. Petropoulos, Norwalk, Conn. (to American Cyanamid Co., New York, N. Y.).

Polymerization of Unsaturated Compounds in the Presence of Bactericidal Phenates of Phenols and Thiophenols. No. 2,873,263. J. Lal, Philadelphia, Pa. (to H. D. Justi & Son, Inc., Philadelphia, Pa.).

Polymeric Materials and Method of Producing Same. No. 2,873,266. S. V. Urs, Chicago, Ill. (to Union Carbide Corp.).

Epoxidation Process. No. 2,873,283. C.-T. Yand, New York, N. Y. (to Shell Development Co., New York, N. Y.).

Molding Composition Comprising Polyvinyl Chloride or Polyethylene and a Metal Oxide. No. 2,874,140. H. Kloepfer, Frankfurt am Main, Germany (to Deutsche Gold- und Silber-Scheideanstalt vormals Roessler, Frankfurt am Main Germany).

Static-Resistant Hydrophobic Resin Composition, Shaped Article Thereof and Method for Making the Latter. No. 2,874,023. A. T. Walter, South Charleston, W. Va. (to Union Carbide Corp.).

Process for the Manufacture of Stabilizer-Plasticizer Compositions. No. 2,874,062. L. M. Kebrich, Brooklyn, and A. W. Stroebel, Forest Hills, N. Y. (to National Lead Co., New York, N. Y.).

Wax Emulsion Polish Containing Oxidized Polyethylene Wax. No. 2,874,137. J. Pisanchyn and H. A. Troutman, Morristown, N. J. (to Allied Chemical Corp.).

Silica-Filled Polycaproamide, No. 2,874,139. N. K. J. Symons, Wilmington, Del. (to E. I. du Pont de Nemours and Co., Wilmington, Del.).

Unsaturated Polyester-Vinyl Monomer Composition Stabilized with 3,6-Di-N-Propylcatechol and Method of Preparation. No. 2,874,141. R. M. Christenson, Richland Township, C. L. Paris, Pittsburgh, and E. E. Parker, Allison Park, Pa. (to Pittsburgh Plate Glass Co.).

Vinyl Resin Compositions Stabilized with Lead Chloride-Lead Silicate Complexes. No. 2,874,145. J. G. Hendricks, Boonton, N. J. and Adrian R. Pitrot, Uniondale, N. Y. (to National Lead Co., New York, N. Y.).

Polymeric Compositions. No. 2,874,146. R. Deverell-Smith, J. Mitchell, and H. J. Twitchett, Manchester, England (to Imperial Chemical Industries, Ltd., London, England).

Production of Phenolic Resins from Alkyl Benzene Hydroperoxides. No. 2,874,147. H. Hock, Clausthal-Zellerfeld, Germany (to Ruhrchemie Aktiengesellschaft, Oberhausen-Holten, Germany).

Ureas. No. 2,874,149. F. Applegath and R. A. Franz, El Dorado, Ark. (to Monsanto Chemical Co., St. Louis, Mo.).

Epoxy Compounds. No. 2,874,150. R. M. Christenson, Richland Township, and J. J. Jaruzelski, Pittsburgh, Pa. (to Pittsburgh Plate Glass Co., Allegheny County, Pa.).

Stabilization of Perfluorochloroolefin Polymers. No. 2,874,198. W. S. Barnhart, Cranford, and R. H. Wade, Ridgeview Drive, N. J. (to Minnesota Mining and Manufacturing Co., St. Paul, Minn.).

Printed copies of patents are available from the Commissioner of Patents, Washington 25, D. C. Prices, 25c each.
—The Editor

Polymerization of Propylene. No. 2,874,153. L. W. Bowman, Westfield, and R. F. Leary, Cranford, N. J. (to Esso Research and Engineering Co.).

Polymerization Process Employing a Perfluorochlorocarboxylic Acid as an Emulsifying Agent. No. 2,874,152. A. N. Bolstad, Maplewood, and R. L. Herbst, Jr., Westfield, N. J. (to Minnesota Mining and Manufacturing Co., St. Paul, Minn.).

Photopolymerization with the Formation of Coherent Plastic Masses. No. 2,875,047. G. Oster, New York, N. Y.

Method of Improving Porous Films of Plasticized Vinyl Polymers. No. 2,875,088. K. Stiehl, Hanau (Main), H. Franz, Niederrodenbach, near Hanau (Main) and J. Valenteyn, Wolfgang, near Hanau (Main), Germany (to Deutsche Gold- und Silber-Scheideanstalt vormals Roessler, Frankfurt am Main, Germany).

Process for the Optical Brightening of Materials of Polyesters. No. 2,875,089. F. Ackermann, Binningen, and A. E. Siegrist, Basel, Switzerland (to Ciba Ltd., Basel, Switzerland).

Coated Polymeric Thermoplastic Dielectric Film. No. 2,875,098. P. S. Blatz, Buffalo, N. Y. (to E. I. du Pont de Nemours and Co., Wilmington, Del.).

Plastic Upholstery Material. No. 2,875,115. De F. Lott and E. G. Hamway, Toledo, O. (to General Tire & Rubber Co., Akron, O.).

Rubbery Composition Comprising a Crystalline Polyester and a Liquid Polyester Reacted with a Diisocyanate. No. 2,880,192. D. H. Coffey, P. C. Johnson, and H. G. White, Blackley, Manchester, England (to Imperial Chemical Industries, Ltd., London, England).

Composition Comprising Chlorinated Ethylenically Unsaturated Linear Polyester and Mixture of Monomers Copolymerizable Therewith. No. 2,880,193. H. P. Marshall, New Providence, and R. E. Davies, Ridgewood, N. J. (to Celanese Corp. of America, N. Y., N. Y.).

Thermosetting Coating Compositions. No. 2,880,194. D. W. Glaser, St. Paul, Minn. (to General Mills, Inc.).

Polyamides from Diphenyladipic Acid. No. 2,880,196. C. E. Frank and H. Greenberg, Cincinnati, O. (to National Distillers and Chemical Corp.).

Segmented Polymers Having a Linear Polymeric Backbone with Linear Polymer Branches Attached Thereto Through Ureido Groups and Process for Preparing Same. No. 2,882,259. R. K. Graham, Moorestown, N. J. (to Rohm & Haas Co., Philadelphia, Pa.).

Equipment

Plastics Extruding Apparatus. No. 2,882,555. G. E. Henning, Baltimore, Md. (to Western Electric Co., Inc., New York, N. Y.).

Equipment for the Pre-Plasticification and the Injection of Thermoplastic Materials. No. 2,881,477. G. Triuizi, Milan, Italy.

Apparatus for Treating Plastic Materials with Electric Glow Discharge. No. 2,881,470. G. H. Berthold, Guilford, and M. B. Karelitz, Fairfield, Conn., and A. S. Mancib, Winchester, Mass. (to Olin Mathieson Chemical Corp., New Haven, Conn.).

Apparatus for Producing Polyvinyl Chloride. No. 2,880,076. C. E. Kircher, Jr., R. J. Jones, and R. F. Kriz, Detroit, Mich. (to Detrex Chemical Industries, Inc., Mich.).

Plastic Mold Base. No. 2,874,409. I. T. Quarnstrom, New Haven, Mich. (to Detroit Mold Engineering Co., Detroit, Mich.).

Attachment of Doll Limb to Doll Body. No. 2,865,134. D. Cohn, Brooklyn, N. Y. (to Model Plastic Corp., White Plains, N. Y.).

A doll limb is inserted into a body aperture of similar shape, but smaller size, where it is secured by a rigid bushing.

Flexible Canteens. No. 2,865,420. R. E. Allenbach, Pueblo, Colo. (to Pueblo Tent and Awning Co., Inc., Pueblo, Colo.).

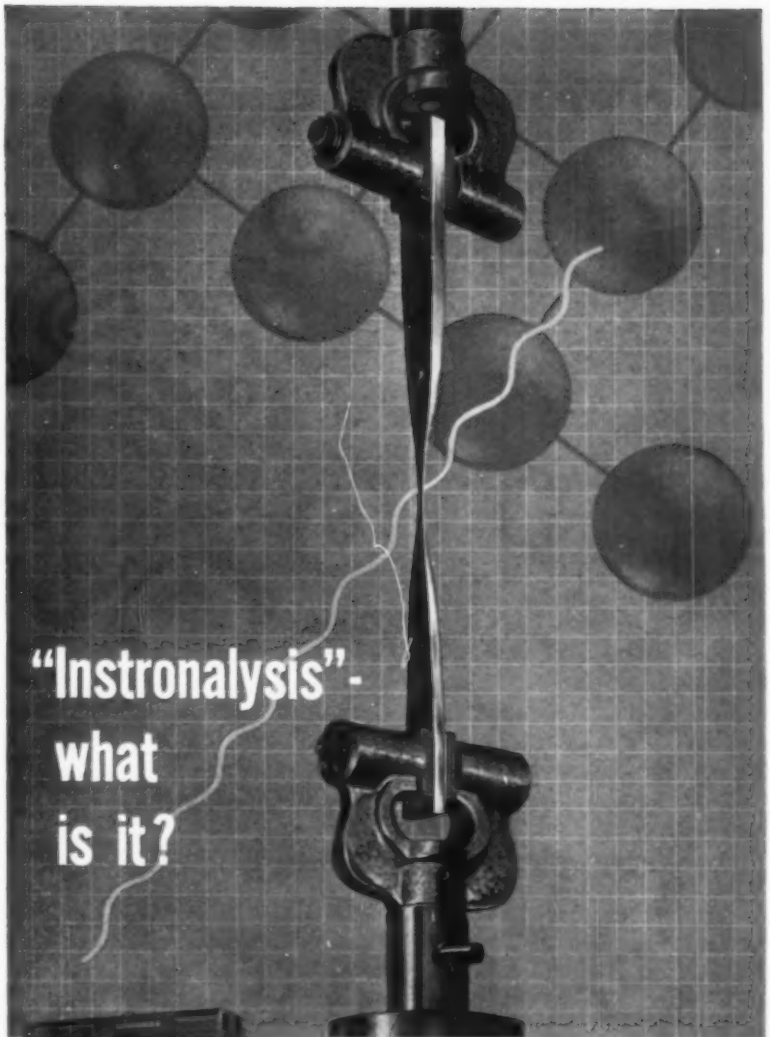
A continuous sheet of flexible waterproof thermoplastic is folded over itself to provide a front and back portion joined at the bottom by the fold. The seams are thermowelded, and a window opening covered with a sheet of flexible absorbent material which acts as a wick. A suspension strap is stitched to the top.

Plastic Novelty and Method of Making the Same. No. 2,866,575. J. J. Lattuca, Hempstead, N. Y. (to Best Plastics Corp., Brooklyn, N. Y.).

A party favor basket, with base and sides formed of a single sheet of thermoplastic material, has two stiffened bows across the top for handles.

Plastic Nozzle or Spout Mounting and Method of Forming Same. No. 2,866,581. J. Henchert, River Forest, Ill. (to Continental Can Co., Inc., New York, N. Y.).

In a container structure, a deformable and resilient plastic nozzle comprising a tubular body including a mounting flange, cylindrical base portion, and metal mounting wall.



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applications and, more particularly, the economical advantages they offer. (In German.)

"Properties and Application of Rilsan Sheet and Film," J. Fouquee, IND. PLASTIQUES MOD., 11, 8, 24 (July-Aug. 1959).

The author describes the properties of Rilsan sheet and film (Rilsan is the French polyamide, polymer of 11 amino-undecanoic acid derived from castor oil) which make them especially suitable for packaging foods; for insulation purposes; for making greenhouses; garments; as intermediate layer in leather transmission belts, etc. The sheet can be vacuum-formed and drawn. (In French.)

"The Use of Low Density Polyethylene Tube in the United Kingdom Water Supply," D. A. Gill, BRIT. PLASTICS, 32, 5, 182 (May 1959).

This is a report summarizing the information obtained from United Kingdom water undertakings in replies to a questionnaire circulated in 1958.

"Microstructure of Polymer Coatings on Magnet Wire," G. W. Recktenwald and D. M. Trollinger, MODERN PLASTICS, 37, 6, 134 (Feb. 1960).

New techniques are described for properly evaluating enamels to coat polymers on magnet wires.

"Foams in Electronics," Roger Jennings, SPE J., 16, 3, 319 (March 1960).

A brief review of applications in potting, missiles, and microwave usages.

General

"Recent Processes for Making Artificial Leather. Survey based on Patent Literature," M. Bottscher, KUNSTSTOFF-RUNDSCHAU, 6, 4, 136; 6, 5, 175 (April & May 1959).

The survey is limited to leather cloths—that is, fabrics and paper or fleeces coated with plastics. About 150 patents are referred to, covering finishes for PVC coats, grains, suede-like or velvety surfaces, breathing leather, and the use of polyurethane, polyamid, silicone, and other rubbers and plastics besides PVC. (In German).

"Construction and Operation of High Frequency Welding Equipment in Conformity with Regulations," V. Klein, KUNSTSTOFFE, 49, 6, 302 (June 1959).

Discussion of the reasons for the regulations on the use of high-frequency equipment and how the laws work in practice.(In German.)

"Slide Rule for Calculating Dimensions and Weight of Plastics Sheeting," K. H. Nehls, KUNSTSTOFFE, 49, 7, 369 (July 1959).

A slide rule for calculating the lengths of rolls of plastics was described in an earlier issue of this journal and now further work in this field has extended the scope of the method. The theoretical development of these slide rules is discussed and a special type, not commercially available, is described. Several examples demonstrate the usefulness of these aids. (In German.)

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CALENDAR of COMING EVENTS

April 20
SPE North Texas Section RETEC. Plastics in the Petroleum and Chemical Industries. Hotel Texas, Fort Worth, Tex.

April 20-21
SPI Cellular Plastics Division Automotive Conference. Statler Hotel, Detroit, Mich.

April 20-22
SPI Third Annual Fluorocarbons Division Meeting. Hotel Roosevelt, New Orleans, La.

April 25-26
American Institute of Electrical Engineers. Twelfth Annual Technical Conference on Rubber and Plastics Industries. Sheraton Hotel, Akron, O.

April 25-26
SPI Eighteenth Annual Canadian Section Conference. London Hotel, London, Ont., Canada.

May 14-29
Foire de Paris. Sixth Exposition of Plastics Materials and Rubber. Parc des Expositions, Paris, France.

May 20-31
Norsk Plastforening. International Plastics Exhibition. Oslo, Norway.

May 23-26
ASME Design Engineering Conference and Show. Statler-Hilton Hotel, New York, N. Y.

June 9-11
Manufacturing Chemists' Association. Annual Meeting. The Greenbrier, White Sulphur Springs, W. Va.

June 20-24
Gordon Research Conferences. Elastomers—Structure and Properties. Colby Junior College, New London, N. H.

July 4-8
Gordon Research Conferences. Polymers. Colby Junior College, New London, N. H.

July 19-21
Western Packaging & Materials Handling Exposition. Pan Pacific Auditorium, Los Angeles, Calif.

September 8-9
SPE Eastern New England Section RETEC. Vinyl Plastics and Plastics in the Shoe Industry. Statler-Hilton Hotel, Boston, Mass.

September 22
SPE Binghamton Section RETEC. Plastics in Business Machines. Sheraton Inn, Binghamton, N. Y.

Domestic Production and Sales of Plastics and Resin Material, November and December, 1959

Following are the partly estimated and revised statistics for the domestic production and sale of plastics and resinous material during the months of November and December, 1959. Units listed are in pounds, dry basis unless otherwise specified. Data on alkyds and rosin modifications have not been included since their use is primarily limited to the protective coating industry.

	November, 1959		December, 1959	
	Production	Sales	Production	Sales
Cellulose Plastics:				
Cellulose acetate and mixed ester:				
Sheets, under 0.003 gage	1,499,139	1,477,284	2,171,551	1,548,591
Sheets, 0.003 gage and over	1,865,936	1,764,571	2,030,792	1,703,382
All other sheets, rods, and tubes (including other cellulose plastics)	731,349	775,851	711,415	790,069
Molding and extrusion materials (including other cellulose plastics)	8,857,451	8,653,138	8,380,061	7,837,381
Nitrocellulose sheets, rods, and tubes	106,047	124,453	215,577	145,699
TOTAL	13,059,922	12,795,297	13,509,396	12,025,122
Phenolic and Other Tar-Acid Resins:				
Molding materials[1]	19,892,653	17,492,992	20,505,507	16,740,009
Bonding and adhesive resins for—				
Laminating (except plywood)	5,872,666	4,029,903	5,807,377	3,912,094
Coated and bonded abrasives	1,339,102	1,152,176	1,406,595	1,128,412
Friction materials (brake linings, clutch facings, and similar materials)	1,241,785	1,011,323	1,572,615	1,352,169
Thermal insulation (fiber glass, rock wool)	4,787,745	4,365,960	4,031,374	4,318,123
Plywood	5,912,472	4,090,150	4,957,063	4,023,665
All other bonding and adhesive uses	5,461,035	4,800,331	5,276,515	5,558,185
Protective-coating resins unmodified and modified except by rosin	2,155,328	1,508,271	2,258,267	1,686,926
Resins for all other uses	4,011,853	3,939,205	3,760,890	3,751,139
TOTAL	50,674,639	42,390,311	49,576,203	42,470,722
Urea and Melamine Resins:				
Textile-treating and textile-coating resins	2,700,858	2,824,419	3,208,349	2,780,217
Paper-treating and paper-coating resins	2,667,983	2,299,582	2,357,100	2,948,550
Bonding and adhesive resins for—				
Laminating	3,020,273	2,230,012	2,494,073	2,172,479
Plywood	8,335,384	8,910,567	8,364,001	9,051,111
All other bonding and adhesive uses	1,658,385	1,722,153	1,385,728	1,538,229
Protective-coating resins, straight and modified	2,799,046	1,868,221	3,011,981	2,097,792
Resins for all other uses, including molding	10,983,282	10,356,362	10,727,203	9,512,392
TOTAL	32,165,211	30,211,316	31,548,435	29,200,770
Styrene Resins:				
Molding and extrusion materials:				
Straight polystyrene	25,995,226	21,962,270	24,769,152	21,157,432
All other	31,255,326	24,935,089	34,885,973	28,465,787
Protective-coatings	6,502,078	5,440,548	7,419,350	5,991,864
Textile and paper treating and coating resins	5,374,265	3,568,304	5,313,215	3,810,847
All other uses	10,999,937	19,093,562	12,882,658	16,900,496
TOTAL	80,126,832	74,999,773	85,270,348	76,326,426
Vinyl and Vinyl Chloride Resins:				
Polyvinyl chloride and copolymer resins (50% or more PVC) for—				
Film (resin content)		7,962,224		7,359,646
Sheeting (resin content)		11,597,652		11,923,442
Molding and extrusion (resin content)		26,408,797		22,603,853
Textile and paper treating and coating (resin content)		3,967,685		4,151,020
Flooring (resin content)		12,800,583		11,481,903
Protective coating (resin content)		2,095,030		2,443,415
All other uses (resin content)		7,242,398		9,885,863
All other vinyl resins for—				
Adhesives (resin content)		4,785,566		4,704,977
Protective coatings (resin content)		1,924,178		2,075,175
All other uses (resin content)		11,220,816		10,139,328
TOTAL	100,469,890	90,004,929	103,701,205	86,903,622
Coumarone-Indene and Petroleum Polymer Resins	18,986,518	18,495,359	16,912,664	17,172,147
Polyester Resins:				
For reinforced plastics				
For all other uses	9,764,028	8,496,989	11,627,814	9,605,574
TOTAL	11,777,081	10,150,091	13,752,471	11,599,835
Polyethylene Resins:				
For film and sheeting		25,444,387		28,638,043
Molding materials		16,971,616		15,753,949
Extrusion materials		13,594,200		12,073,976
For all other uses		32,539,645		31,828,782
TOTAL	110,802,181	88,549,848	112,660,418[1]	88,294,750[2]
Epoxy Resins:				
For protective coatings		1,874,481		1,700,294
For all other uses		1,906,885		1,988,388
TOTAL	4,504,225	3,781,366	4,823,140	3,688,682
Miscellaneous Synthetic Plastics and Resin Materials, Including Silicone Resins	20,412,903	16,996,150	20,818,362	17,400,362
GRAND TOTALS	442,979,401	388,374,440	453,581,642	385,082,438

[1] 10.8% produced by the low-pressure process.
[2] 12.4% produced by the low-pressure process.
SOURCE: United States Tariff Commission, Chemical Division.

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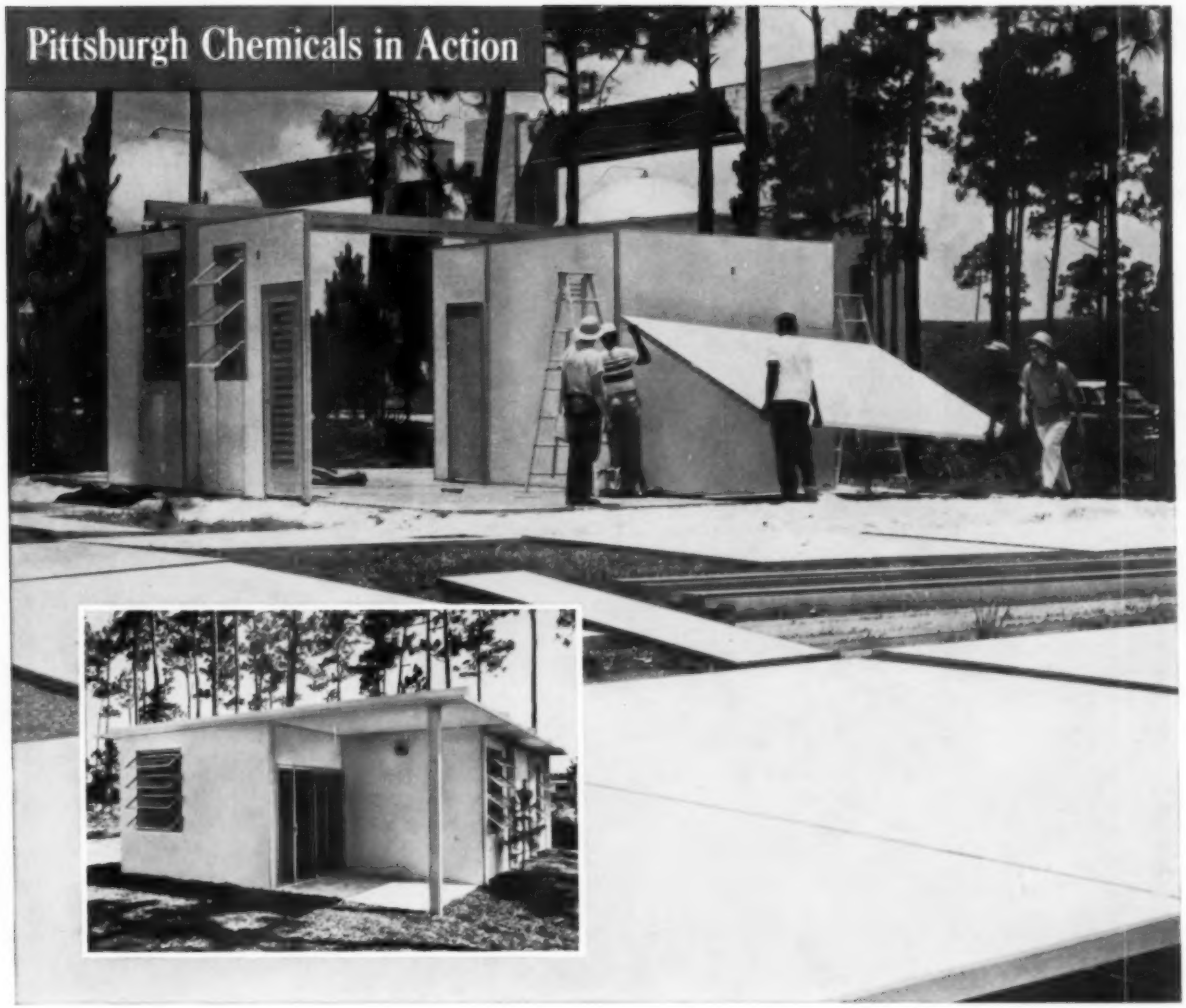

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